THE

ELECTRICAL REVIEW.

VOL. LIV. MARCH 18, 1904. No. 1,373.

ELECTRICAL REVIEW.

Vol. LIV.] CONTENTS: March 18, 1904. [No. 1,373.

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THE

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1904 Edition

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MUNICIPAL TELEPHONY.

AT the Glasgow Town Council there was recently an interesting discussion on the telephone question, arising from a motion of the Convener of the Telephone Committee for power to borrow £50,000 additional capital for the Glasgow Corporation telephone system. The present borrowing powers of £300,000 are nearly exhausted, and the increase of capital is required, according to the Committee's statement, so that new subscribers may be "wired on" without delay. It appears from the published statement of the Committee, that up to January 31st last, the total capital expenditure was £318,562, and at that date the number of instruments working was 10,822. At the meeting of the Town Council the Convener of the Telephone Committee stated that the system now had about 11,000 subscribers. We recommend this statement to the attention of a contemporary which recently denied that "subscribers" and "instruments" are used as interchangeable terms in the Glasgow Town Council. As we pointed out last year (ELECTRICAL REVIEW, October 9th, 1903), of the total instruments in the Glasgow Corporation telephone system, about 18 per cent. are extension and private line stations and other sundries, so that 11,000 instruments represent about 9,000 actual subscribers' lines. However, since in municipal telephone circles it is now preferred to use the instrument as the unit instead of the subscriber's line, which is the unit adopted in all municipal telephone estimates, we will, in the figures below, follow that practice.

The motion for power to borrow more money was opposed by several councillors, who desired further information as to the real standing of the telephone department. Mr. Russell, who jocularly referred to the date as being the telephone borrowing anniversary, it being only a year ago that the Committee borrowed £80,000 of capital, pointed out that on the basis of a depreciation charge of 5 per cent. the telephone department started the current year with a loss of £31,000, and he calculated that on the current year's working there would be a further loss of £4,200, without allowing for interest and sinking fund. Mr. Russell further drew attention to the fact that the Secretary for Scotland, in approving of the last loan of £80,000, did so in reliance on the Corporation setting aside a reserve or depreciation fund sufficient to prevent the reasonable possibility of the system being worked at a loss. This condition has not been complied with, much to the indignation of Mr. Russell, who characterised the financial management of the telephone department as a "commercial scandal." Mr. Bruce Murray followed Mr. Russell in a severe criticism of the finances of the telephone department, but apparently the Council, as a whole, was not willing to listen to any real discussion on the situation of the telephone enterprise, and Mr. Russell's amendment to refer the matter back to the Committee for further information was supported by only five votes, the motion for further borrowing powers being carried by a large majority.

In the articles which we published on the Glasgow Corporation telephone system last year, it was shown, by a careful analysis of the official accounts and statistics, that the system was being conducted on most unsound lines. It is quite evident that the larger the amount of capital spent by the Glasgow Corporation telephone department, the greater will be the reluctance of the Committee to recognise the necessity of a proper allowance for depreciation. Even at 5 per cent. the depreciation charge on the present investment would be £15,000 a year, and this would make a large hole in a gross revenue of about £50,000 a year. It appears now that the Committee has to face not only depreciation but obsolescence of plant, as it is proposed to change the present system of operating. The call-wire system has been found to give such a bad service that it is now considered necessary to adopt some improvement. To carry this out effectively involves the reconstruction of the exchanges and the alteration of subscribers' instruments or their replacement by others of a different pattern, and can only be done at large cost and at the sacrifice of a considerable amount of the present investment.

It becomes more and more evident that the Glasgow Corporation has seriously under-estimated the cost of conducting a city telephone exchange on commercial lines. The average capital cost per instrument at present stands at £30, while the average revenue per instrument is put by Mr. Russell at something less than £4 10s. The gross income is, therefore, about 15 per cent. on the capital cost. If a depreciation charge of but 5 per cent. is made—and, in view of all the circumstances, this is by no means an extravagant figure—the total annual charge for depreciation, interest and sinking fund, will be over 11 per cent., leaving less than 4 per cent. on the capital cost for working expenses. At an average capital cost per instrument of £30, the average amount of revenue available for working expenses, if each instrument contributes its proper share of depreciation, interest and sinking fund, would be only £1 4s. per annum. This amount is clearly insufficient. Either the Glasgow Corporation must raise its rates for telephone service or continue to shelve the question of depreciation and to charge working expenses to capital. In any event, the most conspicuous experiment in municipal cheap telephony can hardly be regarded as an unqualified success or be held up as an example for other municipalities to follow.

THE MODERN ENGINEERING APPRENTICESHIP SYSTEM.

In our Leader of a week or two ago we referred very briefly to the system of apprenticeship in vogue at the American Westinghouse Works, and to the proposal to start a similar system in some of the Tyneside engineering establishments, promising to give further details of these systems as opportunity afforded.

Prior to January, 1896, there was no regular recognised apprentice system in vogue at the Westinghouse Works. Technical graduates and others entering the works were treated exactly alike so far as shop training was concerned. The nature of the work to which a youth was put, and the number of departments through which he passed, depended to a large extent upon his desire to continue any particular class of work, or the impatience he evinced to leave it. This haphazard system was not conducive either to the best interests of the company or of the apprentice. There are now two distinct courses, one for non-technical men, who desire nothing more than to become workmen or foremen, and the other for technical college men or graduates, as the Americans call them, whose intention or ambition is to become electrical engineers; that is to say, managers or superintending engineers, or members of the draughting or testing staff, or in fact, to take up any department of the professional side of the work. In the first class, which is named the "ordinary apprenticeship," the youth is put to that class of work for which, after close observation, he appears to be best fitted, and is kept throughout his course at that particular work. In some cases, however, such apprentices are allowed to spend six months in the drawing office. At the end of his time he has acquired an intimate acquaintance with the various machine tools, and also with the assembling of parts of complete machines. Before being indentured he serves a period of about three months, during which time he has an opportunity of considering whether or not the work is such as he would like to take up permanently; this also gives the company a chance of discovering whether he is worth developing. The minimum age for entering this class of apprenticeship is 17 years, and the rates of pay are—for the first three months, 5 cents per hour; the remainder of the first year 8 cents per hour, rising to 10, 12 and 16 cents per hour for the second, third and fourth years respectively. Overtime is paid for at the rate of time and a-half. If at the end of his time the apprentice has given satisfaction to the company, he is presented with $100 and a diploma.

The other, and higher, course is termed the "engineering apprenticeship," and is only open to technical college graduates. The course is of two years' duration, 16 cents per hour being paid during the first year, and 18 cents during the remainder of the apprenticeship. A three months' trial is required, as in the case of the ordinary apprentice. These graduates are carefully selected, the endeavour of the company being to obtain the highest class of technical men possible. In this course the aim is not to keep a man too long to one particular class of work, but long enough only to enable him to become familiar with it, and not necessarily an expert mechanic. As little as one week may be spent in one department, while in others quite six months are sometimes considered desirable. The capabilities of each apprentice are closely watched by the foreman, and from the reports of these men they are eventually selected for the particular department of work for which they are best fitted.

The social side of the men is developed through an organisation called the Electric Club, which is an organisation entirely separate and distinct from the company itself, although its members include nearly all the apprentices and engineers of the Westinghouse Co. The local section of the Institution of Electrical Engineers meets in the club room once each month, in return for which privilege the members are invited to be present and to take part in the discussions. This club, we believe, was really formed by the Englishmen who were sent out by the British Westinghouse Co. to America, in order to study American methods before taking charge of the various departments of the English works at Trafford Park.

Recently, the North-east Coast Institution of Engineers and Shipbuilders have taken considerable interest in the matter of securing greater efficiency in the education and training of engineers, shipbuilders, and others engaged in industries which require a scientific education. A strong committee, consisting of gentlemen connected with the most important manufacturing works on the Tyne, Wear,

and Tees, were nominated by the council of the Institute to go thoroughly into the matter and endeavour to bring in some practical suggestion to meet the new conditions. It should be noted that the N.E.C. Institution is, perhaps, more in touch with the local manufacturing industries and with the technical colleges than can be said of any other scientific institution. The President, Mr. John Tweedy, is the managing director of Messrs. Wigham, Richardson & Co., and the past-presidents are all leading men either in shipbuilding or in engineering in the North. The same is true of the vice-presidents and members of the council. In addition to this, there are four representatives from the council on Lloyds' sub-committee, four also on the consultative committee to the Board of Trade, a representative on the council of the Durham College of Science, two representatives on the Durham College Metallurgical Education Committee, three on the committees of standard sections, and until it ceased to exist, due to the establishment of an Education Committee under the provisions of the Education Act, 1902, two representatives from the Institution were on the sub-committee of the Northumberland County Technical Education Committee. The President, Mr. Tweedy, and also Prof. Weighton, who is a vice-president of the Institution, and professor of Mechanical Engineering and Naval Architecture at the Durham College of Science, have taken an active part in bringing about a joint committee of the leading Institutions of the country for the purpose of determining how best to raise the standard of training in engineering in all its branches. The practical result of the committee's work is that many of the firms in the North have adopted a system of apprenticeship somewhat on the lines of that described above in connection with the Westinghouse Co.'s works. It is well known that Mr. Yarrow, in London, has already opened his works to young men without any premium whatever, but on the Tyne they have gone a step further than this, and briefly, the system adopted at Walker-on-Tyne is as follows :—

Technical college graduates, who have obtained an approved certificate or a pass degree in engineering or naval architecture, may be admitted to the works as pupils. They will serve for three years, one year being spent in the drawing office, and the scale of pay will be 8s., 15s., 20s. per week in each year. Those who hold a degree with honours, or a certificate of the first class, will receive 5s. per week more pay. There is another class for youths who hold no approved college degree or certificate, but who have passed the matriculation examination required for graduation in engineering science, or an equivalent. Their rate of pay will be the same as that of the ordinary apprentice, and their training will extend for a minimum period of five years, of which at least three academical years must be spent at a technical college.

The third class is for the sons of workmen, and other employés who have entered the works as ordinary apprentices, and who, by passing the matriculation or equivalent examination described in the second class, will be treated as pupils in that class in respect of leave to attend college day classes, promotion, and rate of pay. The promotion will depend solely upon the merit of the individual apprentice and the business requirements of the firm, and is absolutely at the option of the firm.

It is too early yet to obtain any details as to the actual working of this system, which has only been in operation for a few months, but there is no doubt that engineering students on Tyneside are to be envied their opportunities, and it is to be hoped that some similar system may be adopted by the leading electrical engineering firms for the training of electrical engineeers.

Resumption of the Berlin Electric Railway Trials.

It is expected that the interesting experiments with electric locomotives on the military railway between Marienfeld and Zossen, which is now being utilised for the purpose of competitive trials of six different kinds of steam locomotives at the highest speeds attainable, will be resumed in a short time, although the exact date has not yet been fixed. The overhead conductors have remained in position since the suspension of the tests, and the necessary funds have already been provided by the interested firms to enable the experiments to be continued this year. It may not be generally known that in addition to the Siemens and Halske Co. and the Allgemeine Electricity Co., the Studien Gesellschaft fur Elektrische Schnellbahnen (Study Co. for Electric Express Railways), is composed of the Deutsche Bank, A. Borsig, Delbruck, Leo & Co., Philip Holzmann & Co., the Friedrich Krupp Co., the National Bank, J. S. H. Stern, and Van der Zypen & Charlier. Under such influential auspices as are represented by these banking institutions and engineering firms, and supported by the Imperial Government and the monetary vote of the Diet for the reconstruction of the military railway, it is scarcely surprising that it has been possible to extend the trials over a considerable period and attain a speed of over 124 miles an hour, the maximum having been 131 miles. The Deutsche Bank, which was the means of inducing the banks and firms already mentioned to participate in the expenses of conducting the tests, states that the results will not only have a favourable effect upon passenger traffic in general, but also particularly in relation to the development of electric traction on main lines. This statement would appear to imply that, when the appropriate moment arrives, the members of the syndicate will be prepared to finance the construction of a high speed electric railway in Germany, provided that the necessary facilities for proceeding with the work are afforded by the Government.

It is understood that the future experiments to be undertaken by the company will principally consist of trials of endurance. According to Herr Lochner, president of the company, it has been ascertained that the combined distance already travelled by the two locomotives amounts to about 6,200 miles. In his opinion, however, further and more certain results could be obtained if it were possible to proceed with duration trials for a distance exceeding 62,000 miles, and on a longer track than the 13-mile long military railway in the neighbourhood of Berlin. The company, he states, is making endeavours in this direction and hopes to be able to accomplish its object. This statement would appear to confirm the assumption previously drawn from the extract given from the report which has just been issued by the Deutsche Bank.

The experience which has already been gained from the trials will form the subject of a report which is being prepared by the interested engineers. Pending the publication of the document, it may be noted that the experiments have brought to light certain facts which were hitherto unknown in connection with railway working. In the first place, it is said to have been determined by means of measuring instruments that a very considerable portion of the power required by the locomotive or motors is needed to overcome the resistance of the air, the actual amount being stated to be two-thirds of the total power used. A second point relates to the behaviour of the permanent way. It is claimed that the trials have shown that the normal section of rail used on the railway is suitable for train speeds of up to 124 miles an hour, but as only locomotives with trailers—not trains—have been operated on the railway, the assertion seems to lack confirmation. Besides, it was recently stated in Parliament, on behalf of the Government, that the rails in use on the main lines would not permit of the attainment of a higher speed than 74 miles an hour. In the third place it has been found that no damage whatever has been done to the permanent way with a running load which is equivalent to about 16 tons on each axle ; and fourthly, the so-called "twisting motions," which were unpleasantly experienced in the earlier trials, and particularly in the trailing coach, were entirely overcome by the reconstruction of the underframes, and with an increase in the distance between the wheel base from 11 ft. 6 in. to 16 ft. 6 in. With this and other modifications, and with the heavier track which had been laid, it was ascertained that the locomotives travelled comparatively smoothly, even at speeds exceeding 124 miles an hour. The fact that the reconstruction of the permanent way was not responsible for the abolition of the "twisting motions," is illustrated by the coupling of a six-axled coach to one of the locomotives. When the speed was increased from 90 miles to 111 miles an hour, the coach began to "twist" in such a manner that it is said the passengers could scarcely contemplate the possibility of enjoying another night's rest.

THE BERLIN TELETYPING CENTRAL EXCHANGE.

Whenever, in addition to a correct transmission of the news, an acknowledgment in writing of this transmission is required, telephones, which only render words as they are spoken, will be inefficient for business purposes. On the other hand, there is a liability of telephonic conversation being overheard by a third party, and, finally, the person rung up on the telephone may happen to be absent, when his return will have to be waited for, and much time lost.

The Berlin type-printing telegraph central exchange (Ferndrucker Centrale), which was opened to public service on October 1st, is intended to afford an efficient means of communication in such cases. The "Teletyper," as constructed by the Siemens & Halske Co., is a type-printing telegraph, similar to the well-known Hughes type-printer and the Baudot telegraph. The main distinctive feature from former apparatus is, however, the fact that, the latter moving freely, the synchronism of the instruments established on the same line had to be obtained by the skill of the operator, whereas the operation of the new apparatus being nothing else than that of a teletypewriter may be learned by anybody in the shortest possible time. The keyboard of the teletyper is similar to that of an ordinary typewriter, comprising four superposed rows of seven keys each, out of which 26 are each provided both with a letter and a figure or sign of punctuation. As regards the remaining two keys, one serves

Siemens & Halske Teletyper.

as beginning or letter key, whereas the other, bearing the inscription "Zahl," is used as figure or punctuation key. By striking either of these keys, the type-wheel of the printing telegraph is adjusted either for letters or figures in a manner similar to the Hughes apparatus. Each of the apparatus connected by a line may be used either as sender or as receiver without any special preparation or switching being necessary, both of them being automatically and simultaneously operated as soon as the first white key is struck, when the apparatus in question becomes a sender, and all is ready for use.

The type-wheel bears on its periphery in one circle the letters, and in another parallel circle the figures and signs of punctuation. On depressing the shift key, the type-wheel is shifted automatically on its shaft so as to place the row of signs concerned above the printing surface of the paper ribbon. By acting on an ordinary key, on the other hand, the type-wheel is rotated so far as to bring the type in question in front of the paper, when the latter is pressed against the wheel and receives the impression, to return downwards again instantaneously, and to be moved so far as the interval of two letters, so as to be able to receive the following sign. This process will occur simultaneously in both of the apparatus connected by the line—*i.e.*, both in the transmitter and receiver, being automatic in the latter, no matter whether there is or is not somebody operating the receiving apparatus. In the case of the owner of the apparatus being absent, the telegram may be read on the paper ribbon on his return. The electric printing telegraph will thus give two perfectly similar records of the same telegram, one on the sending and another on the receiving apparatus.

As soon as the beginning key is pressed downwards, the circuit of the transmitting apparatus is completed, resulting in a switching roller being set rotating, throwing electric currents of alternating directions into the printing telegraph circuit and through the line relays connected to the apparatus; the latter will insert both in the transmitting and receiving apparatus, local currents which, by means of so-called relay magnets, produce the rotation of the type-wheel from the initial position identical in all the stations. Now, in the case of a letter key being pressed downwards, a peg attached to the other end of its lever will strike against the rotating switching roller brush, stopping the latter and thus the type-wheel of the printing telegraph. At the same time the type levers of both apparatus being attracted will cause the corresponding letter to be printed. As long as the key is pressed downwards, the type-wheels are incapable of moving any further, thus enabling the transmission to take place at any desired speed. After a telegram is transmitted, both the transmitter and the receiver will be switched out automatically at a certain position of the type-wheel, the apparatus thus being stopped automatically. Twelve accumulator cells, fixed into a box, serve as working battery. The pressure obtaining in the line circuit is so low as to exclude any possibility of an inductive influence being exerted by printing telegraph circuits on neighbouring telephone circuits.

The advantages afforded by the printing telegraph, as compared with present telegraph and telephone systems, will be evident. Like the telephone, the printing telegraph may serve for a direct communication between two persons over any distance, but has the additional advantage of any hearing mistakes or other misunderstandings being excluded by the double and simultaneous reproduction of the communication in printing. As above stated, the printing telegraph will, at the same time, make it impossible for a third person to overhear communications, which is possible in the case of the Morse telegraph. This is, therefore, the only means of communication enabling despatches to be kept strictly private.

The central exchange just opened is fitted with a switchboard having indicators and jacks for 100 subscribers. Sixteen connecting cords allow of 32 subscribers being simultaneously connected so as to enable a simultaneous communication between a third of all the subscribers in the case of the switchboard being complete. As soon as a subscriber presses down the calling key of his teletyper, the official in charge of the indicator board of the central exchange will be advised by the indicator of the subscriber in question dropping, and an alarm being rung, when he will put himself in communication with the caller, in order to ask for the desired connection, and connect both subscribers so that their apparatus are ready for direct communication. This shows the similarity of service with telephone service, and the great advantage of any two subscribers communicating directly. There is, however, in addition the possibility of connecting any desired number of subscribers to the same printing telegraph, so as to transmit the same communication simultaneously to all the subscribers.

Similar telegraphic services from one central office to a certain number of subscribers simultaneously by a so-called "ticker" have for some time been in use in New York, London and Paris. A similar service has been in operation also in Bremerhaven, Germany, for transmitting ship telegrams from one central office to 100 subscribers in different places. The central exchange just opened in Berlin is also intended, in addition to the mutual communication between the subscribers, to transmit similar information to a certain number of subscribers, limiting the service at first to Exchange telegrams. The same system of communication could be employed for transmitting telegrams from a central telegraph office, such as Reuter's, to a certain number of newspaper offices. In addition, the above exchange is intended to secure communication with the central telegraph office for transmitting or receiving telegrams through the State

telegraphs. The new system has been in use for some time with great industrial concerns, such as the Berlin Allgemeine Elektrizitäts Gesellschaft and the Siemens & Halske Co. for communication between their various departments.

MESSRS. GRAHAM, MORTON & CO.'S NEW ENGINEERING WORKS, LEEDS.

On Friday last an informal inspection of these new works took place, a large number of visitors being entertained to luncheon at the works by Messrs. Graham, Morton & Co., Ltd. The construction of the works and offices, which has been carried out entirely by the firm's own employés, was begun on May 16th last year, and was completed on November 2nd—an achievement which was claimed as a record. The establishment is situated in Hunslet, on a site of 7 acres, the works covering over 7,000 sq. yds., and the offices 1,200 sq. yds.; railway sidings running into the works connect with the Great Northern railway adjoining.

The works consist of three bays, in all 386 ft. long and 146 ft. wide; the structure is of steel, lavishly lighted from the sides and roofs, and well ventilated. Two-thirds of the floor space are occupied with the plating and erecting shops; there is also a large fitting shop, at one end of which are the stores and tool room, with the chain department over. The bays are served by four electric 10-ton cranes, each fitted with two 8-H.P. and one 5-H.P. "P.D.M." motors. There are a large number of modern machine tools, mostly of British make. Almost the whole of the machinery is electrically driven, there being 12 P.D.M. motors in the shops of 25 to 7½ H.P.—150 H.P. in all—running at 600 r.p.m., and driving countershafting. The crane motors are operated by B.T.H. traction controllers, while the shop motors are controlled by Cutler-Hammer starting-switches. The power station contains two 150-KW. E.C.C. dynamos coupled to two-crank compound Belliss engines, and a 34-KW. dynamo built by the Phœnix Dynamo Manufacturing Co., belt-driven, for lighting. The main switchboard, as well as the wiring for power and lighting, was supplied by Messrs. Crompton & Co., Ltd. Hydraulic pumps for the presses are fixed in the power house, while an air-compressor for the pneumatic tools is driven by a motor in the works.

The offices are very commodious, and include accommodation for 50 draughtsmen, as well as the managerial and commercial staffs.

At the time of our visit some large orders were in hand in the shops, including a steel building for Harrismith electricity works, South Africa, excavating machines for underground railway tunnels, a number of railway bridges, coal and ash conveyors, colliery corves, &c., including several contracts for electrical authorities and companies. Messrs. Graham, Morton & Co. have recently constructed in Edinburgh the largest installation of inclined gas retorts in the world, costing £113,000, and a similar installation in Milan, costing £108,000; other gas works in hand are for Paris and Leeds, the latter of which was inspected by a number of the visitors. As one of our most energetic and wideawake British firms, who are well able to hold their own with foreign competition, Messrs. Graham, Morton & Co., Ltd., merit our sincere congratulations on the completion of their new works.

REVIEWS.

The Practical Physics of the Modern Steam Boiler. By Fred. J. Rowan, A.M.I.C.E., &c. London: P. S. King and Son. 1903. 21s. net.

Mr. Rowan's aim in the present work is to deal with the fundamental principles affecting the form, action and efficiency of steam boilers. He treats almost exclusively of water-tube boilers, and hardly attempts to discuss the cylindrical boiler at all. The work has evidently been under preparation for some years; in fact, the author states in his preface that "the major portion of this work was written early in 1898," and its publication has been delayed consequent upon the immense amount of labour involved in giving chapter and verse for the innumerable patents cited in the chapter on the historical development of the "Water-tube Boiler." This appears to us a pity, as much of the recent discussion on boilers is entirely ignored; for instance, the whole work of the Boiler Committee is practically confined to a scanty reference in the preface, and the reader will search in vain for any reference to the Committee's work in the index. Though the results of the Committee's labours may still be incomplete, yet in a book of reference, which is essentially the character and object of Mr. Rowan's present work, there should have been added a more complete reference to the trials already published by the Committee.

Mr. Rowan endeavours to direct the reader's attention to the principles underlying correct boiler construction and use, rather than to the proportion of any one particular area or surface to that of another. For instance, it is not so much a question as to how much coal can be burned in a given grate, as to what is the largest quantity which can be efficiently burned in a given time at the highest temperature attainable and with the minimum of labour. Again, with the furnace gases, it is the question of the number of feet per second at which they traverse the H.S., and the number of thermal units transmitted per square foot per second; or it is the question as to what is the greatest velocity that can be imparted to the water, and that in a contrary direction to the furnace gases. Mr. Rowan endeavours to deal with the other questions underlying boiler construction in a similar way, rather from the physical point of view than from the severely practical side. He makes no claim to originality in the vast majority of the information placed at the disposal of the reader; on the contrary, the object he desires to attain has been to place in the hands of engineers a volume where they may have ready and easy access to all the principal data that have been published on water-tube boilers, without having to constantly refer to the pages of *Engineering*, Inst. C.E. *Proceedings*, Bertin, Robertson and other authors.

An immense amount of research is condensed in the historical chapter, and hundreds of patents, with their numbers and years, are cited. This information will be extremely useful to a few, but to the ordinary reader it cuts up the thread of the narrative very considerably, and will tend only to bewilder many, more particularly as, amidst this mass of information, it is practically impossible to tell which boilers have been brought to a successful practical issue, and which have died in the state of infancy, or which have not even got further than the pages of a patent specification. One comes away with a feeling, after perusing this chapter, that there is nothing new under the sun, and that several minds at different times evolved the same ideas unbeknown to one another.

Prof. Thurston has written a preface to the work, in which he compliments the author on "this novel and valuable contribution to the literature of the subject," and is "much interested in finding so large a portion of the work devoted to the water-tube boiler," and he "looks forward to the time when their use will become general, to the exclusion older and more dangerous forms of boiler."

Mr. Rowan demurs, in the first chapter, dealing with general considerations in the selection of the best type of boiler, at the conditions laid down by some previous authors, and he proceeds to cite ten points as against the five stated previously. Now, it appears to us that though the five points previously given may be, and are, open to criticism, yet Mr. Rowan's ideal points are equally or more so.

If Mr. Rowan intended the points he cites to refer exclusively, or even primarily, to high-speed marine work, then he may be correct in placing so much importance on the question of weight, but for the vast majority of land work, weight is not of such vital importance, and should take a very secondary place as compared with many other questions, such as "facilities of repairs," "prime cost," and "cost of maintenance," which points he refers to.

In Chapter II. Mr. Rowan deals with "Some Fundamental Elements of Boiler Design," and here he wisely lays emphasis on a question too often overlooked in steam boiler design, and which is a fruitful cause of starting weaknesses leading often to accidents—viz., the fatigue of metals. In closing

he gives certain "axiomatic statements" as to the requirements that must be aimed at in competent boiler design.

Chapter III. is devoted to "Combustion," and Chapter IV. to "Transmission of Heat," and in these chapters we find all the classical experiments by Durston, Yarrow, Pietet, Bleckynden, Hirsch and others fully described and illustrated.

Chapter V. is devoted to the important subject of "Circulation of Water"—a subject of paramount importance when dealing with water-tube boilers, and the neglect or want of appreciation of this subject has led to more water-tube boiler failures than any other cause. Mr. Rowan says there are two kinds of circulation (1) due to the natural action of boiling; (2) that due to mechanical means or artificial circulation. Under natural circulation, Mr. Rowan goes over all the various papers and discussion before the Institution of Naval Architects and the Institution of Civil Engineers, and other learned societies, which have taken place on the papers read by Thornycroft, Normand, Watkinson, M. de Chasseloup-Laubat, and others. Under "forced circulation" Mr. Rowan says that there should be a development of this system, but he gives no information as to what attempts have been made in this direction, nor does he dwell upon the great practical difficulties attending any attempt at the mechanical forced circulation which he appears to advocate—mechanical circulation with pressures at from 300 to 400 lbs. sq. in. would greatly add to the anxieties and responsibilities of those in charge, say, of the 30 boilers of some of our large vessels. He quotes one example of a "film" circulator, but it can hardly be termed a happy choice.

Chapter VI. deals with "The Influence of Temperature on Tenacity and Ductility." A great deal of information is collected from various sources, but much of the information would be better fitted to a work on metallurgy, and the practical application of the information given to the construction and maintenance of boilers might with advantage have been more clearly set forth.

Passing over the chapter on Corrosion and Incrustation, which Mr. Rowan summarises in a few practical and pointed remarks, we come to Chapter VIII., which is devoted to a "Historical Sketch of Boiler Designs." This chapter, which consists of about 150 pages alone, must have involved a very great amount of care and labour in its preparation. The author draws liberally from Bertin, Thurston, Chasseloup-Laubat, Robertson and others, and to the information drawn from these sources, he adds an enormous number of references from the Patent Office records. As a collection of information from all available sources this chapter should prove a most valuable asset to the information on boiler development.

The closing chapter is devoted to Tests and Results, and here again Mr. Rowan has taken whole pages from Bertin, *Proceedings* I.C.E., photographing them down into blocks, with the result that some of the tables can hardly be read without the aid of a magnifying glass.

We think the publishers would have better advised had they made two volumes of the work instead of trying to cram all the information into one volume.

The work is an able and comprehensive compilation of the encyclopædia type, and Mr. Rowan is to be congratulated on the completion of a work which must have taken a vast amount of industry and care in its preparation, and which cannot fail to interest all those interested in the subject of water-tube boilers.

The Practical Testing of Dynamos and Motors. By Charles F. Smith. Manchester: The Scientific Publishing Co. 5s. net.

It is seldom the reviewer has had through his hands a book he can more cordially recommend for all-round excellence than this little treatise. It is a comparatively elementary non-mathematical introduction to the study of continuous-current dynamo machinery, giving full instructions for the carrying out of the more usual tests on machines of different kinds. The treatment of the subject is thorough and lucid, and the diagrams, and especially the numerous curves got from actual tests, are all excellently reproduced in a very clear manner.

A station engineer, or, in fact, anyone possessing average common sense and some electrical knowledge, would find in this book all the information he wanted to enable him to set about making the necessary tests on any continuous-current machine to see if it complied with a given specification, or to determine its fundamental constants and obtain for himself valuable information as to the merits or demerits of its design.

The book begins by a few pages of practical hints regarding instruments, the keeping of notes, &c., and warnings as to possible pitfalls, which are obviously derived from considerable experience in carrying out the tests described. Then follow 13 chapters dealing in detail with the measurement of armature and field resistances, the production of E.M.F. and its relation to speed, magnetisation, influence of air-gap, armature reaction, characteristic curves for different types of machines, and methods of carrying out at varying loads all the usual tests, such as the Hopkinson and Swinburne tests, concluding with a chapter on the regulation of three-wire systems and on the testing of balancers and boosters.

In the chapter on the measurement of resistance, attention is drawn to the gross unreliability of the usual method of determining the rise of temperature of field magnets by means of mercury thermometers attached in various positions and covered by wadding or other non-conductor. The results obtained by this method are shown by means of curves and contrasted with those got from determinations of the actual resistance of the field windings when hot, assuming a value for the temperature coefficient of copper, which in this case is given correctly as ·428 per cent. per degree Centigrade at the ordinary temperature.

In the chapter on miscellaneous tests, several pages are devoted to the different methods of determining the voltage round the commutator. Though the information given is fairly complete, it would have been improved by further details as to the size and materials of the revolving disc and brushes, points of great importance if the test is to be satisfactory, as neither wood nor ebonite is available for the disc if intended for permanent accurate work. A figure showing how the accessories required are to be applied to an ordinary machine would have been more useful than fig. 60, showing an arrangement quite inapplicable in most cases.

We hope a book of similar character to the present volume, and dealing with alternating-current plant, may soon be available. J. A. H.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Tramway Depreciation.

Re your excellent reference in regard to the above in your issue of March 4th, you do, from time to time, give good advice to consulting and constructing engineers; but in the majority of cases it apparently goes unheeded.

It is high time that tramway engineers should do some solid thinking with reference to the future. In my opinion the "Southampton" experience is only the forerunner of a "series" of very expensive experiences, which numerous corporations will undergo long before the year 1910 arrives.

The first and highly essential step in tramway construction should take the form of a solid "concrete" foundation all the way across the track bed, from 6 to 12 in. deep (according to the nature of the ground), and should in width finish off at "not less" than 2 ft. on the outside of each rail.

A second method is for the rails to be laid and "spiked" on wooden "sleepers," and the sleepers completely embedded in good solid concrete; and a third method, more suitable for light railways through country, is for the rails to be spiked on good "creosoted" sleepers, the rails resting on "metal tie-plates," to prevent the rails cutting into the sleepers, and the whole track to be well "ballasted."

It is, of course, needless to say that such a track foundation should be well drained, but how often is this highly important condition ever given a thought.

It is absolutely a "useless" waste of time and money to

place rails upon a "poor" foundation, and adopting heavy rails, welded joints, heavy fishplates, anchoring beams, &c., are under such conditions only patching up, for the time being, what is in the very beginning a "bad job."

Turning our attention to the track itself. As regards the smooth running of the car, the following conditions are essential:—(*a*) Track lengths "level" on the "tread" of the rail; (*b*) true to gauge; (*c*) wide grooves; (*d*) curves of large radii; (*e*) grooves free from stones, dirt, sand, &c. These conditions, in addition to tending to smooth running of the car wheels, affect the "resistance to traction" (and, therefore, the power consumed per car) and also the "life" of the rails; additional conditions which affect the "life" of the rails are nature and steepness of gradients, composition of the rails, kind of traffic on track (whether "passenger" or "merchandise," with heavy rolling stock), and last, but not least, the "weight" of the rails, and the form of the "cross-section" of the rail.

These last two conditions are easily controlled by "specification," and there ought to be no reason why engineers should not make departures from existing conditions.

In my book, "Practical Construction of Electric Tramways" (Spon), I recommend that the weights of rails should vary from 95 to 120 lbs. per yard.

As to the question of the form of rail section, I am of the opinion, taken from a "durability" point of view, that the rail section can be greatly improved on; and the "life" of the rail depends at the outset more on its form than on any other condition (neglecting, of course, its metallurgical composition).

From a "tractive resistance" and "consumption of power" point of view, the "grooved girder type" of rail, as generally adopted, is the very worst type possible. A better form from this standpoint is the "step girder rail," and, better still, the "T-headed girder rail."

Whereas under average conditions the "tractive resistance" for "grooved girder rails is about 30 lbs. per ton, ditto for the "step girder rail" is about 18 to 20, and for the "T-headed girder rail" about 12 to 15 lbs. per ton. The only advantage which a "grooved girder rail" possesses is that it enables the street pavement to be more readily and closely laid. It has several very great disadvantages. Cars do not keep the track better on a "grooved girder rail"; in fact, it is otherwise. The "step girder" and T-headed girder rails are safer, and in going round curves they only need "guard rails."

In fact, "grooved" girder rails should never be used on tramways or light railways laid through country where there is no pavement.

The proper rail for light railway construction is, in my opinion, the T-headed girder type, because (*a*) it is safer; (*b*) it has less "tractive resistance"; (*c*) it is more "durable"; and (*d*) for reason (*c*) it is more "practicable" and "commercial" for the rolling stock used in the carriage of merchandise; (*e*) a lighter weight rail with greater durability can be built in this form than any other.

The Hampshire Light Railway (recently constructed) have used the "grooved girder rails" on the ballasted track through country; I believe it would have been a wiser policy to have used T-headed rails.

In my opinion the present type of "grooved" girder rail can be improved, especially in the distribution of metal.

The force of this suggestion will be more readily realised when the existing tramways have had the experience of rolling stock carrying heavy merchandise passing over them.

On the question of "depreciation allowance," the majority of the tramway undertakings are taking the "average" life of the track as 10 or 12 years, and are allowing about £450 per annum per mile of single track. I should suggest that they take respectively seven or eight years and £600 per annum as their basis.

A number of extensive tramway undertakings are contemplating the "carriage of merchandise"; this is to be confined to night and early morning, and the "passenger traffic" during the other hours; under such conditions they will find that five years will be nearer the "average" life of the track (and they will have to allow "depreciation" accordingly), because "goods traffic" abuses the track more than "passenger traffic."

With "continuous vibration," due to continuous traffic, a rail becomes "tired," and the fibrous structure of the metal of the rail assumes a "crystalline" formation; this is one of the reasons of "short life," also why a rail deteriorates more rapidly towards the end of its life than at the beginning.

In conclusion, I beg to offer a hint for serious investigators. The "track" is utilised (in the case of the "overhead" system) as a return circuit for the electric current, and I suggest that this "polarises" the "molecular structure" of the metal, and, in so doing, affects the life of the rail.

I, therefore, suggest that samples of rail before installation, and after being in use for some time, should be submitted to chemical and microscopical observation. I believe that the knowledge thus gained will be of incalculable practical and commercial value to the tramway world, and have a great bearing on the future. If such "polarisation" does occur, with detrimental results, then some of the present methods of installation will have to be altered.

Wm. R. Bowker.

March 10th, 1904.

The National Position of Steam Coal.

The alarm in some quarters about the rapid diminution of our best steam coal is only natural, but not well founded. Steam is not likely to continue much longer as the vehicle of heat energy in fluid pressure motors. The gas producer and internal combustion engine are destined to supersede steam, and, with the disappearance of steam, steam coal will not be required. Good coal is thrown away on a gas producer. One pound of cheap slack coal will give as much B.H.P., without smoke, as 2 lbs. of best steam coal, the former burned in a producer and gas engine and the latter in a boiler for steam raising.

This cold truth has immense significance to the live engineer, while others are scanning the distant horizon for some appearance of improvements to reduce the consumption of steam coal, or for artificial interference with its mining and sale. The solution of the difficulty is under their very noses, and wise engineers have been quietly adopting gas producers and gas engines for power purposes.

Having had the subject of adapting the gas producer to ship propulsion in hand for over two years, I can affirm that it is certain to be as successful at sea as on land—the producer being altered, of course, and the engine designed for working on board ship; this direction of progress, however, is not electrical, but still it may be of interest. Steam coal is a necessity on warships, and good coal always necessary on all ships employing steam boilers, hence the present large consumption of high-class coal.

For large generating electric centres for power purposes, the Trafford Park installation is an instance in point of gas power.

Much has been written and talked about saving our coal supply, but when the question is probed to the bottom, the talk usually turns out to be, like the now customary discourses about educating engineers, much on a level with the casual remarks exchanged between parties about the weather. The modern gas producer is at hand to save any amount of coal in all the industries in which heat is necessary. And in a great many cases it has been adopted with vast savings, both for heat and motive power purposes. But the strange feature of the situation is that those who cry out most about the rapid consumption of high-class coal, either ignore the existence of gas producers or are not aware of their existence.

Cheap energy, either as mechanical or electrical power, can be obtained only by converting the energy of cheap coal in a gas producer and gas engine.

To those interested in the cheap supply of electrical energy for industrial purposes, it should be a matter of vital importance to establish their works on the coal fields, purchase cheap slack, and get electrical energy in abundance at a price per unit even less than that from a waterfall.

This vital question, however, is never heard of. Instead of adopting the most recent developments of power production, we find the projectors of large power schemes proposing to use the old boilers and engines, and all the rest of the use

and wont engineering practices. They are consequently doomed to early failure; no steam power plant can supply electricity at a price anything near what it can be made for by any power user with his own gas producer and gas engine, even at as low a unit as 50 B.H.P.

The steam turbine for a time has given steam power a fillip which may prolong its supposed supremacy, but the internal combustion engine, capable of using any fuel in a gas producer and converting *one fourth* of the heat energy of that fuel into actual brake horse-power, is bound to prevail in the end, and the fact to be realised is that we are not waiting for it, it has come and is ready for the work.

At any rate, any discussion about "steam coal" should take into account the use of cheap coal or "power coal;" steam no longer holds the predominance in power working that it did in recent times.

The main question nowadays is not "How are we to get cheap steam power?" but "How are we to get cheaper —— power?" The hyphen will by the up-to-date engineer be filled in by the words steam, gas or water, according to circumstances, and where cheap slack coal is plentiful the word would be gas, if a cheap waterfall was available the word filled in would be water.

R. Kennedy.

Osmium Lamps.

Would one of your readers kindly inform me where I could obtain osmium lamps?

Cambridge.

R. E. J.

Municipal Appointments.

In view of the numerous letters you have published recently from unsuccessful and apparently discontented candidates for municipal appointments, the following extract from one of Mr. Blake's articles in the *Business World*, may be helpful: "The patience and perseverance, the resisting of temptations, the industry and energy required to overcome and to accomplish—the possession of these qualities is the best 'pull' a young man can have, and it is more sure than the doubtful and short-lived influence of a friend. The young man who secures or retains a position from any other reason than one of fitness and capacity is unfortunate."

This is as true and as applicable in the engineering as in the business world.

A. J. B.

The Sterilization of Water by Ozone.

The question of the sterilization of water by ozone has of late received some attention, but, so far, very little information has been published giving details of the systems, or how far they have been a success, either experimentally or commercially.

Might I, through the medium of your columns, ask if any reader can supply particulars as to what has been, or is being, done in this direction?

E. T. W.

Electricity in Mines.

With reference to the correspondence on this matter the writer is reminded of a story. There was once a colliery manager whose barometer was out of order, and noticing that an ass belonging to a neighbouring farmer always brayed on the approach of a change in the weather, he hired the ass to take the place of the barometer, and thus instruct him in barometric variations. But alas! and alack!! from that day onward his life was made ever miserable, by every other ass instructing him as to *how* he should work his pit.

T. Campbell Futers.

Another Voice from Shanghai.

You will be pleased to hear that our municipal competition is now at an end. We called a special ratepayers' meeting, and it was decided by a majority of 4 to 1 that the municipality, in dealing with fittings, &c., were exceeding the limits of legitimate municipal trading. We must thank you for your excellent article, "A Voice from Shanghai" (Elec. Rev., September 1st, 1903), which we used, along with several of your leading articles on Municipal Trading, in our fight with the Council.

A Correspondent at Shanghai.

[It is always a pleasure to hear from our friends who are connected with electrical development in places far away. It is satisfactory to learn that the Shanghai Council has been led to recognise that private electrical trading has rights which must not be disregarded, and it is the more gratifying to us to know that the Electrical Review was influential in bringing about this very desirable result. We are continually receiving evidence of the interest with which Britishers in the Colonies and foreign parts welcome the arrival of our journal, and of the eagerness with which they scan its contents. Perhaps our 'cross-the-water readers will remember that news from them as to electrical events is equally acceptable to our great connection of readers at home.—Eds. E.R.]

Gas v. Electricity.

I should like to thank Mr. H. Waymouth Prance for the interesting figures he has given me in his letter of March 1st, under the heading "Gas *v.* Electricity," and whilst on the subject, to congratulate "Development Engineer" on his excellent suggestions.

The professional canvasser has but little difficulty in persuading the man who has sense enough to absorb the fact that even at a higher cost per C.P. per hour, electric lighting offers so many advantages over gas lighting as to make it infinitely cheaper in the end.

It cannot be denied, I am afraid, that in almost every neighbourhood there is a class of consumer, in some cases a large portion of the residents, who cannot be induced to see this. This class of consumer, whose load is well worth attempting to secure, finds an additional flavour lent to "margarine" by the fact that its first cost is less than that of "butter."

Far be it that I should revile the professional canvasser—his lot is hard enough—yet I feel sure "Development Engineer's" private canvassers would penetrate where he can never hope to.

I believe that many waverers, who meet the arguments of the professional canvasser with the proverbial bulldog, would not only listen to, but be converted by, the blandishments of their neighbours and friends.

I take it, "Development Engineer's" scheme need not stop at private residents and free wiring. Surely shopkeepers might, with advantage, be enlisted; for tradesmen are most prone to merely compare bills for current with those for gas during similar quarters of the year.

With regard to the inducement to be offered these private canvassers, "Development Engineer's" suggestion that payment should be made "in kind" is a good one. Monetary transactions between them and the local supply company should be avoided. Perhaps one unit free per 8-C.P. lamp connected through their efforts to the mains would answer. The question is one that presents difficulties.

An energetic and persuasive individual might succeed in inducing several of his acquaintances to install lights, or even motors, amounting in 8-C.P. equivalents to double his own installation.

In a case of this sort, where the private canvasser earned in a quarter, say, one and a half times his quarter's consumption in units free, then he might be further rewarded by giving him the value of the surplus free units in extra lighting or improvements to his installation.

Again, in the case of a free-wired canvasser, these surplus units might be put to his credit account, at a fixed rate per unit, towards a fund enabling him to purchase his own installation.

As the private canvasser's premises would, in all probability, as his show room, be one of his strong arguments, it would pay to deal liberally with him when giving him the value of surplus free units in improvements and additions to his installation.

Where traction and lighting are combined, the extra reward could take the form of passes on the cars lasting for various periods.

Proving claims would be simplified by getting intending

consumers to write on their application forms "introduced by Mr. So and So."

I hope, with "Development Engineer," that others will give their views on this question which is of interest to all trying to push electric lighting in small towns.

Agnostic.

The Curtis Turbine.

Many claims have been made to prove the superiority of the steam turbine over the reciprocating engine, but of all, the most astounding is that promulgated by Mr. F. Samuelson in his paper, read before the Rugby Engineering Society, abstracts of which are given in your issue of the 4th inst.

In his paper we are informed that "to handle higher degrees of vacuum in an engine, it would be necessary to make the cylinders very large, which will not only increase the size and weight of parts but also friction in working, so as to fix a practical limit which cannot be passed without excessive cost and complication." All this looks very nice on paper, and sounds well to any engineer not thoroughly versed in the theory and practice of steam engineering, but all practical men will undoubtedly deem it an erroneous idea.

As a simple illustration, take two engines of similar power, working with the same initial steam pressure, length of stroke and piston speed, one engine being non-condensing and the other condensing. In such cases I have always found the non-condensing engine has the largest cylinders, whilst in that designed to work condensing the cylinders decrease in size according to the degree of vacuum specified, and consequently the parts, instead of becoming costly and heavy, are just the reverse, and as for complications, they are no greater in one case than the other.

If I am wrong, will someone kindly correct me; but such statements as the above certainly require verification.

Arcturus.

[Mr. P. W. Willans, in his classic papers, showed clearly the impossibility of utilising high degrees of expansion in reciprocating condensing engines, owing to the fact that the additional losses would more than compensate for the gains. These difficulties are not met with in turbines.

As for the cylinders being larger for the same power when non-condensing, this is a totally different matter; it is obvious that, when an engine has to work against a back pressure of, say, 18 lbs. per sq. in., instead of 3 lbs., the cylinders *must* be larger, and more steam must be used.—Eds. E.R.]

Magnetic Lampholder.

In your last issue dated March 11th, we notice a paragraph on page 417 headed "Magnetic Lampholder." It mentions a firm in Birmingham who are supplying these lampholders. We beg to point out to you that we are the sole agents for these articles for the United Kingdom and the Colonies, and by applying direct to us, those in the trade can obtain proper quotations such as they are entitled to.

The Typewriting Telegraph Corporation, Ltd.

92, Queen Victoria Street,
London, E.C.
March 15th, 1904.

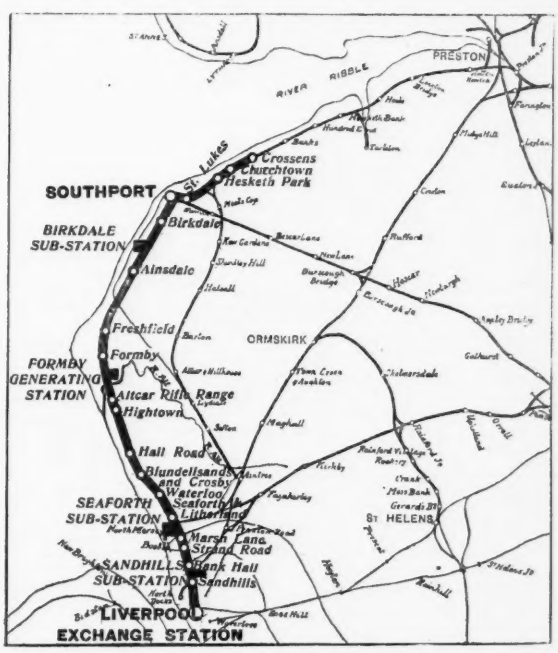
["Central Station" inquires the name of makers of "Etna" engine oil.—Eds. E.R.]

LIVERPOOL—SOUTHPORT AND CROSSENS ELECTRIC RAILWAY.

On Saturday last, by invitation of the contractors, Messrs. Dick, Kerr & Co., Ltd., and of the Lancashire and Yorkshire Railway Co., we took part in a visit of inspection to the newly electrified portion of the railway company's system. Leaving the Exchange Station, Liverpool, at 11 a.m., we travelled in one of the electric trains to Southport, a distance of 18½ miles, in 23 minutes, the speed recorded reaching 59 miles per hour; the motion, however, was so smooth and easy that it was difficult to realise that this high speed was attained. As the train was stopped by signal for some time when nearing Southport, the average speed must have been well over 50 miles per hour. The train was under perfect control, the acceleration being rapid but uniform, and in no way inconvenient.

On the return journey a short stop was made to inspect the Birkdale sub-station, which is fed with three-phase current at 7,500 volts, 25 cycles per second, from the power station at Formby, and supplies direct current to the railway at 600 volts. Another halt was made at the power station for half an hour; here there are four 1,500-kw. Dick-Kerr alternators, direct driven by Yates & Thom horizontal compound Corliss engines, and a 750-kw. set in course of erection. The power station embodies many interesting features, which will be fully described in our next issue.

Afterwards the visitors returned to Liverpool, exceedingly pleased with the trip, which was in every way a success. The whole of the undertaking has been carried out by the contractors, Messrs. Dick, Kerr & Co., in a style to compare favourably with any electric railway that we have seen, at home or abroad; and seeing that this, besides being their first large railway undertaking, is also the largest and most important venture of the kind to be completed in this



Electrically Operated Section of L. & Y. Railway.

country, the success which has been attained reflects the greatest credit alike upon the contractors themselves, and upon Mr. J. A. F. Aspinall, general manager of the L. & Y. Railway Co., to whose designs the work has been carried out. Special commendation is also due to the Railway Co., who, instead of shivering on the brink in constant apprehension lest some new system of electric traction should be devised, like some of their more timorous compeers, have boldly taken the plunge, and we hope will quickly gain their reward.

It has become almost generally accepted that electrification offers the most satisfactory means by which the great railway companies may recover the local traffic which has been to a great extent captured by electric tramways. Moreover, the speedier and more frequent service which accrues from the adoption of electricity serves as an inducement to a suburban population to live further away from the great industrial centres; but, beyond this, electricity permits of a greater development of traffic than is possible under steam conditions.

The scheme for the electrification of the Liverpool and Southport branch of the Lancashire and Yorkshire Railway

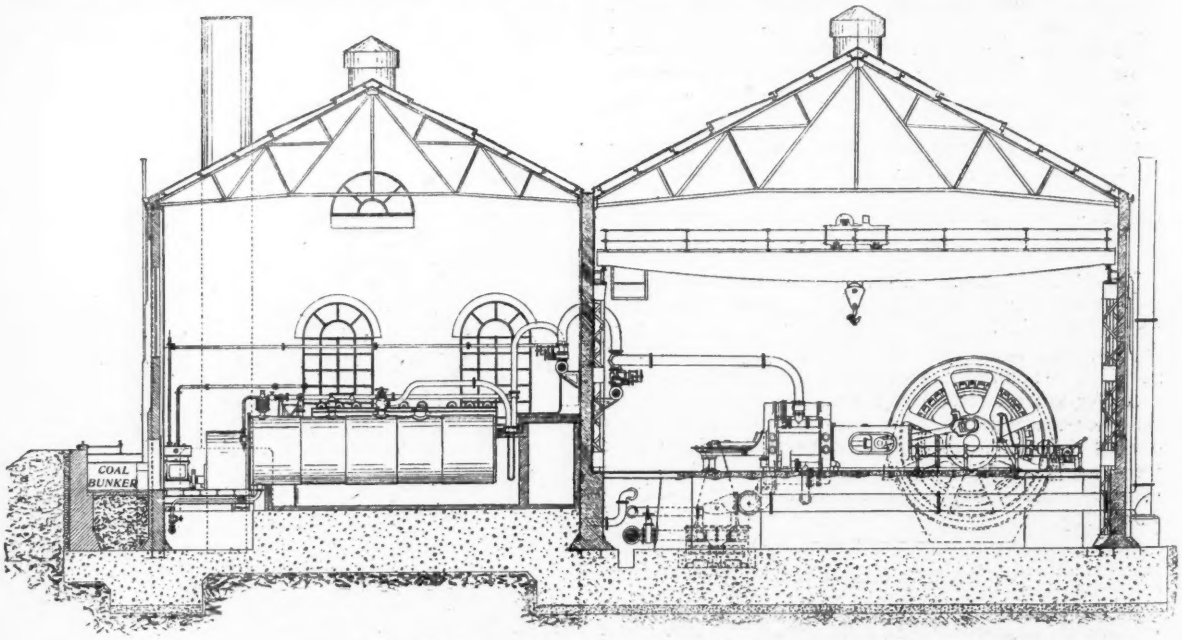
had been maturing for a considerable time before any public announcement was made on the subject. The scheme generally was originated by Mr. J. A. F. Aspinall, the general manager of the company, who long ago realised the possibilities of great traffic development in the excellent residential districts which lie between Liverpool and Southport, and on the north side of the latter town. The new service, with its greater facilities, will, no doubt, lead many Liverpool business men to take up their residence on the north side of the city, and particularly in the charming suburbs on the further side of Southport; for the electrified line, having been extended to Crossens, enables the district, as regards convenience, to rival the residential neighbourhoods of the Wirral peninsular which lie on the south side of the river.

The decision to electrify having been made, no time was lost in putting the work in hand. The complete scheme, with the exception of the rolling stock, which was made at the Horwich and Newton Heath works of the railway company, was entrusted to Messrs. Dick, Kerr & Co., Ltd., of London, Preston and Kilmarnock, who may take credit for being the first firm in England to carry out and complete a scheme of this magnitude. It may be interesting to note that the work of electrifying the line has been completed in a remarkably short time; twelve months ago the work of construction had not been begun, yet on March 1st, 1904, a scheme embracing 47 miles of permanent way, a transmission plant of 12,000 H.P. and a complete train system have been carried out. It is further to be remembered that this has been achieved without interference with the running of the steam service. These results are mainly due to the untiring energy of Mr. Aspinall, seconded by the efforts of the contractors.

The distance between Liverpool and Southport is nearly 18½ miles, the total length of track equipped being practically equivalent to 47 miles of single line. The gradients on the road are slight, and there are but few curves, the steepest gradient being a short length of 1 in 85 near Waterloo, and the sharpest curve one of 7 chains at Southport; with these exceptions the line is level and straight. There are 14 intermediate stations, which lie at an average distance of about one mile apart on the southernmost portion of the route, but are more widely separated on the northern portion. The traffic is almost wholly passenger, business people going to and returning from Liverpool in the morning and evening, with a considerable shopping and miscellaneous traffic during the day.

Under steam conditions, there are about 36 trains per day in each direction between Liverpool and Southport; a similar number running in each direction between Liverpool and Hall Road, a station some 7 miles from Liverpool. The majority of these trains stop at every station, a few expresses being run in the morning and evening for the accommodation of the business men. The running times are at present as follows:—Express trains 25 minutes, stopping trains 54 minutes, Hall Road stopping trains 25 minutes. The total train mileage per diem is about 1,900.

With electrified conditions the train mileage will be increased to 3,200. The number of trains in each direction between Liverpool and Southport will be increased from 36 to 65, and between Liverpool and Hall Road from 38 to 54. Moreover, the running time from Liverpool to Southport will be decreased from 54 minutes at present, to 37 minutes, and from Liverpool to Hall Road from 25 minutes to 17 minutes; the schedule time of the fast trains will remain unaltered, but there will be an express in each direction hourly, instead of only rarely. In addition to this, the express trains will run on to Crossens, giving that suburb a service of 17 trains each way during the day. These arrangements, however, do not represent the ultimate capacity of the line, and if the traffic in the course of a year or two were to demand it, there would be no difficulty in running an even more frequent service. It is intended to shorten the stops at the intermediate stations, and as this will make fresh arrangements necessary to deal with heavy luggage and parcels, a special baggage car has been built to deal only with this service. This car will make numerous trips between Liverpool and Southport, and will immensely increase the ease and rapidity with which parcels can be delivered in the residential districts between Liverpool and Southport.



Cross-Sectional Elevation of Power Station.

General Outline of System.

The portion of the line which has been electrified is shown on the map on p. 453, and it is obvious that the distance, quite apart from conditions of service, demanded a system of high pressure transmission. The electrical energy is generated as three-phase alternating current of 7,500 volts pressure, and transmitted direct to sub-stations, where the voltage is stepped down by statics and transformed by rotary converters into direct current of 650 volts pressure, the maximum voltage at the train being 600.

The power house is situated approximately about the centre of the line, near Formby, directly on the River Alt, being thus favourably situated as regards economical distribution and a plentiful supply of water. The power house is utilised at the same time as a sub-station, from whence part of the electric energy is distributed direct to the adjacent track. In addition to the rotary converters at the main power house, the scheme embraces three sub-stations, the first being at Sandhills, the second at Seaforth, and the third

at Birkdale. The distances of these sub-stations from Liverpool are as follows :—

Sandhills station, distance from Liverpool	...	...	2 miles
Seaforth sub-station, distance from Liverpool	...	...	3¾ "
Formby power house sub-station, distance from Liverpool			10¼ "
Birkdale sub-station, distance from Liverpool	...	...	16½ "

Near Liverpool it has been necessary to arrange the sub-stations closer together than on other parts of the line, in order to cope with the considerably heavier traffic of the local trains running from Liverpool to Hall Road, and *vice versâ*. The extreme ends of the line—from Sandhills sub-station towards Liverpool, and from Birkdale sub-station towards Southport and Crossens—are each fed by one sub-station, whilst, for the intermediate sections of the line two sub-stations participate in supplying energy to the trains, the demand of energy supplied from each sub-station depending on the position of the train between the sub-stations. The sub-stations are situated near the track, thus avoiding any low tension cabling, except a short connecting length.

The system is arranged so that any sub-station can be disconnected, if required.

(To be continued.)

PARLIAMENTARY.

North and South Woolwich Electric Railway Bill.

This Bill came before the Select Committee of the House of of Commons, of which Mr. Russell Rea is chairman, on Thursday last week.

Sir Ralph Littler, K.C., who opened the case for the promoters, said that the Bill sought power to incorporate a company for the purpose of the construction of a tube railway under the Thames from North to South Woolwich. The capital powers sought were for £240,000 with borrowing powers for a third of that amount. At the present time the only means of communication between the two points was by means of a free ferry. That ferry was dangerous in time of fogs, and owing to its irregularity it was the custom of many firms on the south side of the river to discharge those of their men who lived on the north directly the winter months came on. The Bill proposed to construct a single tube railway starting from the gates of Woolwich Arsenal on the south and terminating on the north side of the river. The line would be a single one worked on the shuttle system. The carriages would have electric motors fitted on them instead of having separate motor cars such as those originally used on the Central London Railway. The platforms would be of sufficient length to accommodate a train of six coaches, each train to be capable of carrying 630 passengers. The necessary current would be taken from the Woolwich Borough Council.

At the conclusion of counsel's speech a number of witnesses were called. Major Isaacs, one of the promoters, said that he did not think there was much chance of the L.C.C. constructing a tunnel for some time to come. Cross-examined by Mr. Lewis Coward, K.C. (for the L.C.C.) Witness said that he did not know that the Council had under consideration such a scheme as that of the company. If their Bill were sanctioned he should certainly seek compensation in the case of the construction of such a subway by the L.C.C. It was the intention of the company to construct the line as a self-contained railway, and in no other manner; there was no intention to convert the railway into an electric tramway. Col. A. H. Bagnall, of the War Office, supported the scheme on behalf of Woolwich Arsenal. Mr. Bryceman, the Town Clerk of Woolwich, was the next witness called. He gave evidence of deputations having been sent to the L.C.C., asking that body to construct a subway. They were informed that owing to the commitments of the L.C.C., the matter would have to be postponed. He had written to the Council as recently as January last, but had received no reply. Sir James Szlumper, M.I.C.E., the engineer to the scheme, said that the railway would be three-quarters of a mile in length. As the line was a single one the cost would be comparatively small, both with regard to construction and working expenses. The service would be a 6-minute one, the trains doing the journey in 3 minutes. The cost of constructing had been estimated at £233,376.

Mr. Lewis Coward, on behalf of the L.C.C., called Mr. Strauss, the vice-chairman of the Bridges Committee of that body, who gave evidence with regard to the Council's scheme. The Committee adjourned.

On Friday, Sir Ralph Littler, K.C., having replied to the opposition, the Committee declared the preamble of the Bill to be proved, subject to the insertion of clauses to the effect that the promoters of the Bill were not to oppose, save on details, any application of the L.C.C., in a future Session, and also that the company should not be entitled to compensation by reason of the construction of such a subway by the Council. Sir R. Littler asked that the matter might be adjourned until the promoters had considered the position as it might be found that, under such condition, the Bill would not be proceeded with. The Committee accordingly adjourned until Tuesday.

Baker Street and Waterloo Railway Bill.

This Bill came before Mr. Russell Rea's Select Committee of the House of Commons on March 8th. The promoters were represented by Mr. Balfour Browne, K.C., who, in opening the case, stated that the Bill was to empower the company to execute further works in connection with their undertaking. It was proposed to construct a station at Kennington Road, another at Regent's Park, and to enlarge the tunnels in the Edgware Road for the purposes of a station. None of these proposals were contained in the original scheme. The capital powers sought by the Bill were to the amount of £384,000. The Chairman: Does that include the borrowing powers?—Mr. Balfour Browne, K.C.: Yes, Sir, it does.

Continuing, he said that a material part of the money would be spent on the Kennington Road and the Regent's Park stations, which would take £168,000, and to this must be added the outlay for equipment, which would bring the total up to £244,000. The Bill further sought for power to carry out improvements all over the authorised line. It was proposed to convert every carriage into a motor car, which it was thought would possibly result in a diminution of vibration and a consequent smaller chance of liability for compensation. Then the company proposed to introduce various improvements which would render the railway safer in case of fire. Such improvements would consist of the introduction of concrete in many cases where wood was now in use, and also the provision of insulated returns. The cost of converting the carriages into motor-cars would be somewhere about £90,000, while the other items would run into £50,000. At this point Mr. Balfour Browne was called away to another Committee, and Mr. Shaw, who appeared with him, dealt at some length with the various petitions against the Bill. These petitions came from the London County Council, the Southwark Borough Council, and the Borough Council of Lambeth.

Mr. W. R. Galbraith, engineer to the company, was then called, and in the course of his evidence said that the total expenditure on the railway up to the present time had been £1,522,000. The company would take their current from the large generating station belonging to the Underground Co. in Lots Road, Chelsea.

After cross-examination, Mr. Pollock (for the L.C.C.) hinted that in all probability he would be able to settle the clauses his clients required without further troubling the Committee; that would limit his opposition to the question of finance. The Committee then adjourned.

On Wednesday, Mr. Pollock, K.C., addressed the Committee on behalf of the London County Council, who opposed the Bill on the question of finance. He contended that the capital proposed to be raised by the Bill was capital wanted auxiliary to powers already conferred by Parliament. It was necessary to prevent an undue inflation of capital, the dividend on which would not allow the low fares which would make the line useful to the public. Lord Windsor's Committee had said that tube railways should be constructed on sound financial principles, and at the least possible cost. The capital already authorised was £3,179,000, and of this 1½ million remained, sufficient, he contended, for the company's purposes.

The Chairman at this juncture asked if the promoters of the Bill would bring a responsible official of the company who would give further evidence on the question of capital powers.

Mr. Balfour Browne said that he would endeavour to do so, and on that understanding the Committee adjourned until Thursday.

Weights and Measures (Metric System) Bill.

The Select Committee of the House of Lords appointed to consider this Bill met last week and heard evidence, Lord Belhaven in the chair.

Col. Sir H. Jekyll, assistant secretary of the Railway Department of the Board of Trade, submitted a number of amendments to the Bill which had been suggested by the Board of Trade. The first was to alter the date of the beginning of the Act from 1906, as proposed in Clause 1, to 1909. Two years was too short an interval to allow between the passing and the beginning of the Act, especially if the power to postpone the beginning were limited in the manner proposed in a subsequent amendment to the clause. In foreign countries the shortest time in which the change had been accomplished was four years. The Board of Trade proposed to add the following new sub-section to Clause 1:—"An Order in Council postponing the date of the commencement of this Act may fix different dates for the commencement of this Act as respects weights and as respects measures, and the date or dates fixed by any postponing order may be extended by a subsequent order, provided that no postponing order shall be made unless his Majesty is satisfied that the metric system of weights and measures is not, and will not in the near future be, adopted generally in English-speaking countries." It was desirable that the Act should not be brought into operation in England so long as the present system was continued in the Colonies and the United States, the trade of the United Kingdom with those countries being of greater value than that of the trade with the countries which had hitherto adopted the metric system.

Lord Kelvin thought it was very objectionable that they should hold out the idea that we were waiting on the action of the United States. If the amendment were incorporated in the Bill, he should move subsequently to substitute the words "British Colonies" for "English-speaking countries."

The Chairman asked whether it was the fact that a large number of the Colonies had intimated that they could not attempt to make an alteration in the present system unless the Imperial Government gave them a lead.

Sir H. Jekyll said that was so. Several provisoes were suggested

by the Department to Clause 6, in order to save existing contracts; to allow contracts with persons residing in countries which did not use the metric system to be made in terms of the weights and measures current in those countries; to exempt land in the United Kingdom which had been surveyed in accordance with the present system from the metric system; to save the mile, so as to prevent the dislocation of all railway rates charged on so much per mile; and to take power to exempt certain trades and businesses for them operation of the Act. New clauses were proposed by the department to emphasise the duty of local authorities to provide the necessary local metric standard before the metric system became compulsory, and to impose on the Board of Trade the duty of giving due publicity to the date when the metric system would become compulsory, and to give them power to take such steps as they thought expedient for facilitating the transition from the present system to the metric system.

Mr. H. J. Chaney, superintendent of the Standards Department of the Board of Trade, also gave evidence.

The Committee adjourned.

Middlesbrough, Stockton-on-Tees and Thornaby Tramways.—The Standing Orders Committee of the House of Commons has reported that the Standing Orders may be dispensed with and this Bill allowed to proceed, provided that the powers to construct tramways Nos. 1, 2 and 2A, which are outside the urban district of Eston, be struck out unless the consents of the local authority be proved before the Committee which will consider the Bill, and provided also that the powers to construct tramways 4 and 5, and so much of tramway 3 as is outside the borough of Thornaby-on-Tees be struck out.

Metropolitan Railway Bill.—On Friday the Metropoliton Railway Bill came before a Select Committee of the House of Lords, presided over by Lord Kintore. The Bill seeks to convert and consolidate the existing capital and to raise additional capital of £750,000, and to borrow in respect of this additional capital £25,000. On the Bill being mentioned, it was stated that the opposition had been withdrawn, and consequently the measure will go to the Committee on Unopposed Bills.

Soothill Nether Tramways.—This Bill came before Mr. Egerton's Select Committee of the House of Commons on Tuesday. Mr. Wedderburn, K.C., said that the Bill was promoted by the Urban District Council of Soothill Nether, who sought powers for the construction of 2½ miles of tramways. The scheme was of a purely local character. There were two petitions against the Bill, one from the Great Northern Railway on the ground of competition, and one from the Wakefield and District Light Railway Co., who stated that they had a Bill for lines in Soothill Nether now before the Light Railway Commissioners. Mr. J. H. Rhodes, engineer to the U.D.C., was called. The Bill proposed to raise capital to the amount of £39,000 for the purposes of tramways, street improvements in connection with the tramways, and for a refuse destructor. He considered that there was no doubt that the scheme of tramways would pay. Mr. J. E. Waller, consulting engineer, said that the tramways would be on the trolley system. There were no engineering difficulties. There could not possibly be any competition with the Great Northern Railway. The Committee adjourned.

North Staffordshire Railway Bill.—On 10th and 11th inst., a Select Committee of the House of Commons, presided over by Mr. Kimber, considered the Bill being promoted by the North Staffordshire Railway Co., which, amongst other things, asks for power to enable the company to convert and adapt their railway and canal for use and working by electrical energy, and to construct and equip generating stations, and purchase rolling stock, vessels, and plant, motors, and tramways, for electric traction; and further to provide tugs to be worked by electricity. Sir R. Littler, K.C., who appeared for the promoters, stated that there was no opposition to this portion of the Bill, and the preamble, so far as the electricity clauses were concerned, was passed.

Petitions Withdrawn.—The following opponents have withdrawn their opposition to Bills:—Paddington Borough Council, to the Baker Street and Waterloo Railway; London, Brighton and South Coast Railway, to the East London and Lower Thames Electric Power; the L.C.C. and the Grand Junction Water Co., to the Harrow Road and Paddington Tramways, and to the London United Tramways; the East Ham U.D.C., to the North and South Woolwich Electric Railway.

Doncaster Corporation Bill.—Mr. Parker Smith presided over the Court of Referees on Thursday last week, when an application was made by the Yorkshire Electric Power Company for a *locus standi* in the case of the Doncaster Corporation Bill. Mr. Freeman K.C., who represented the company, said the corporation in their Bill were asking for powers to extend the district in which they were empowered to supply electricity for power purposes to places outside the limits of their order of 1898, those limits being the borough boundaries. If this were allowed it would mean that the Corporation could set up direct competition against his clients. It was decided to give the company the *locus* asked for.

Preston and Blackburn Tramways.—This Bill came before the Select Committee of the House of Lords, of which Lord Kintore is chairman, last week. The Hon. J. D. Fitzgerald, who opened the case for the promoters, said that the Bill was for the incorporation of a company for the construction and working of 6 miles of tramway to connect Preston and Blackburn, in both of which places existing systems would be connected up. The capital asked for was £250,000, and the equipment of the line would cost £150,000. The only opposition to the scheme was that of the Lancashire and Yorkshire Railway, who petitioned on grounds of competition. Mr. Stephen Sellon, the engineer to the scheme, was called, and said that the tramways would run along the main road and would be worked on the trolley system. After hearing further evidence, both for the promoters and petitioners, the Committee found the preamble of he Bill proved, and *it* was ordered for third reading.

Preston, Chorley, and Horwich Tramways.—This Bill was under the consideration of Lord Kintore's Select Committee of the House of Lords last week. The promoters sought to deviate a bridge which was authorised last Session in connection with a scheme of tramways. The bridge was over the Lancashire and Yorkshire Railway at Bamber Bridge, and would have been in the place of a level crossing. After these powers had been obtained the local authority objected to the bridge being placed in that position, and desired that it should be constructed further down the line. This would have involved a detour of some considerable distance and the tramway company would not agree to it. A number of witnesses were called and the Committee adjourned. On Monday after hearing further arguments from counsel, the Committee decided on an alternative scheme suggested by Mr. Balfour Browne, that the tramway should go by the route to Cockstock Hall.

St. Marylebone Electric Lighting Bill.—On Friday the St. Marylebone Borough Council came before the Examiners of Standing Orders with a petition for new provision to be inserted in their electric lighting Bill. The new clause gives the Borough Council power to enter into agreements with companies in respect of (*a*) the execution, maintenance, and management of any works needed for the purposes of the electric light undertaking; (*b*) the supply and maintenance by the working company in and during the continuance of any such agreement, all such mains, plant, &c. It also provides for the performance by the working company of the duties, obligations, and powers of the Council under their Electric Lighting Acts, including the fixing, subject to the authorised maximum rates, and the collecting of the rates, charges, and revenues arising in respect of the electric lighting undertaking of the Council. The petition was opposed by the Gas Light and Coke Co. It was found that the new provision had not complied with Standing Orders, and consequently the matter was ordered to go before the Standing Orders Committee, to decide whether they should be incorporated in the Bill.

The Standing Orders Committee considered the matter on Tuesday. The Committee decided that the Standing Orders might be dispensed with so that the additional provision might be incorporated in the Bill.

Metropolitan Railway Bill.—Lord Balfour of Burleigh's Committee of the House of Lords on Unopposed Bills considered the Bill of the Metropolitan Railway on Tuesday. The report on the Bill was deferred to enable the promoters to bring up a clause requiring that, in the case of receipts for interest on stocks standing in more than one name, notices should be given to all shareholders interested.

LEGAL.

Vigor *v.* Chloride Electrical Storage Co., Ltd.

This case came before Mr. Justice Grantham and a special jury in the King's Bench Division on March 8th. Plaintiff, Frederick George Vigor, claimed from the defendant company damages incurred by him by reason of the defendants' breach of warranty on the sale of certain secondary batteries to the plaintiff. The defendants denied liability for the damage incurred.

Mr. Frank Dodd appeared for the plaintiff, and Mr. Horridge, K.C., Mr. A. J. Walter and Mr. Macpherson for the defendants.

Mr. Dodd said that in the year 1899 plaintiff required an electrical installation at his house at Lingfield, Sussex, and he received an estimate from defendants of £168 for supplying a battery of 54 cells. In March, 1900, the battery was supplied, but it was unsuccessful and began to deteriorate, and showed signs of weakness from an early stage. The lead plates perforated and showed signs of deterioration, causing short-circuiting which rendered the cells for the time being perfectly useless for the purpose of electric lighting used in the house. In consequence of complaints, experiments were made in 1900, and up to a certain date the battery was being watched. In October, 1900, the house was occupied by an Indian Maharajah, and during the time he occupied the house the electric lighting was insufficient. Instead of charging the battery and trusting to it to supply all the electric lighting, he had to run a dynamo and get the electric light in that way, which was more costly. He was told the battery was ample for the size of the house, and if it had been a proper one, it would have been all that was needed. From time to time complaints were made. In October they sent down the daily records, kept by the engineers, to the defendants in Manchester. A properly made battery should last seven years. This one was practically useless at the end of 12 to 15 months. In November, 1901, defendants undertook to put the battery in something like repair, and they sent down a man and did something, for which they claimed £36 odd. While that work was being done, the plaintiff sent down a Mr. Miller, an electrical engineer, and he made a report on December 3rd, 1901. He found that the plates were not sufficiently strong for their purpose. Mr. Partington, the defendants' manager, on the same day also made a report. What that report said they did not know, and they were now told that the report of Mr. Partington had been lost. He understood that one of the suggestions the defendants made was that the plaintiff had "under-charged," viz., reduced the amount of electricity stored below a certain quantity. The end of the battery was that it became perfectly useless, and not being able to get anything from the defendants in respect to it, the present action was commenced. The plaintiff had been put to extra expense by running the dynamo when it was necessary to run it, and after allowing a reasonable sum for the time the battery had been in use, there was a substantial sum due to the plaintiff.

The hearing was continued on March 9th, and a great deal of

evidence was given. On March 10th a long discussion took place on letters which had passed between Mr. Vigor and McKinley as to whether the former did not look upon Messrs. Barker & Co. as principals and not as his agents for the supply of the battery in question.

At one stage his Lordship said he thought it looked as though Barker & Co. were the persons liable to the plaintiff if anybody was. Mr. Dodd said there was evidence that the contract was made direct between Vigor and the defendant company. Mr. Horridge said it appeared that there had been an arbitration between Vigor and Barker & Co. about this very thing. Mr. Vigor said that the arbitration between Barker & Co. and himself was as to what was due to him from them as director and what was due from him to them as director. He made no counter-claim against Barker & Co. on account of these storage batteries.

After further evidence, the jury stated that they agreed on a verdict for the defendants.

His Lordship said he agreed with the verdict, and gave judgment accordingly for the company with costs, and also for the company on their claim in the action for £36, with costs.

Callender's Cable Co. *v.* Killarney Electric Lighting Co.

Last week Mr. Brunskill applied, on behalf of Messrs. Crompton and Co., Ltd., London, for liberty to issue a writ of summons against the Killarney Electric Lighting Co. for the recovery of certain machinery—namely, an alternator, capable of giving an output of 80 to 100 kw. at 2,000 volts to 2,200 volts, the property of the applicants, now in the possession of the Killarney Electric Lighting Co., as the receiver appointed under a hire purchase agreement of June 20th, 1899, for non-payments of instalments due, or, in the alternative, for an order that the machinery be delivered forthwith to the applicants or the instalments paid. The arrangement was that £12 per month was to be paid for the alternator in question, and on payment of this sum for 12 months, with £1 in addition, the machine was to become the property of the hirer. His clients had only received payment for six months, and could not get the balance.

Mr. P. White appeared for the plaintiff. The defendant company was not represented.

The Master of the Rolls said on the receiver appearing and plaintiff not objecting, he would make an order that the machine in question should be delivered up.

Dixon *v.* The Ito Syndicate.

This case came before Mr. Justice Channell, sitting without a jury, in the King's Bench Division on Monday, Tuesday and Wednesday last. The action was taken by the widow of the late Mr. T. J. Dixon, a contractor, to recover from the defendant company £7,401 1s. 8d. alleged to be due under an agreement dated June 15th, 1902, made between Dixon and the defendants, whereby defendants agreed to pay certain amounts for work done according to certificates given by the plaintiff's engineer. Defendants denied liability and counterclaimed for £8,000.

Mr. Pickford, K.C., and Mr. L. Davis appeared for the plaintiff, and Mr. Rufus Isaacs, K.C., and Mr. Clavill Salter, K.C., for the defendants.

The plaintiff's case was that an agreement was entered into between the United Kingdom Tramway, Light Railway and Electrical Syndicate, the defendant syndicate and the West Riding Tramways and Electricity Supply Co., Ltd., whereby the defendants undertook to do certain work ordered by the West Riding Co., and an agreement was entered into on June 13th following between defendants and Dixon that he should execute the work for £220,000, of which at least £110,000 should be paid in cash or shares, at the option of the West Riding Tramways. Dixon duly carried out a certain part of the contract, and defendants paid him £6,732 upon engineer's certificates. On April 25th, 1903, a further sum of £7,401 became due from them to him under the agreement upon the usual certificates of the engineer, but defendants refused to pay him.

Defendants' case was that in September, 1902, they entered into negotiations with one Schenk, for the sale to him of the tramway orders, and on November 27th, 1902, entered into an agreement with him to that effect. A term of that agreement was that Schenk was to discharge all payments and obligations, and that Dixon had full knowledge of that. Defendants admitted that Dixon had executed part of the work and had been paid by them £6,732, but denied that they were liable for the further £7,401 claimed. Defendants counterclaimed for £8,000 for monies said to have been expended by them in consequence of Dixon's work under the contract being defective.

Evidence was given by the plaintiff's son that the work done by Mr. Dixon was satisfactory.

Other evidence being given on behalf of the plaintiff, Mr. Rufus Isaacs said he did not dispute that Mr. Schenk refused to let Mr. Dixon continue the work and gave it to someone else.

Answering his Lordship, Mr. Pickford said he would like to call witnesses who would speak of the profit which they thought would have been made upon the contract by the plaintiff, by reason of his knowledge of making trams in this particular district and knowing the ground.

Additional evidence was then called.

Mr. Alfred Dickinson, M.I.C.E., said he had had 30 years' experience in the management and construction of tramways. He had seen the tramway in question and had seen the agreed schedule prices based on the typical mile, and he had also seen other items making up the £220,000.

Mr. Pickford: What do you say would be the profit upon that contract if carried out?—Witness: My estimate of the profit is £35,788.

Mr. Rufus Isaacs addressed the Court on behalf of the defendants. His submission was that the plaintiff should have been very thankful that he had not gone on doing the work. The whole basis upon which he based his claim was the assumption that he was dealing with a contractor who was able to pay him £220,000 in cash. If he had been dealing with a contractor of that kind, counsel pointed out that the contract price would have been very different. It was a fact that Mr. Dixon could not go on, because he could not get any money. He thought there was material evidence that before Mr. Schenk came upon the scene Mr. Dixon was not going to do any more work for the Ito Syndicate.

Evidence was then called on behalf of the defendants.

Mr. R. H. Sutton, consulting engineer, spoke to having inspected the tramway in question, and he expressed his opinion that it had been badly laid.

His Lordship, in giving judgment on Wednesday, said that on the certificate the plaintiff was entitled to the £7,401 1s. 8d. It was admitted that there were certain things which were required to be done in order to remedy defects on the tramway line in question, and plaintiff said that for this £300 was required. Witnesses on the other side, however, said it would cost from £7,000 to £8,000 to put the line in a position to satisfy the requirements of the Board of Trade. Whilst he (the learned judge) thought that the contractor was responsible for doing his work properly in accordance with the directions given to him, as contractor, by the engineers, he was not responsible for anything which might have to be done in order to alter the design to comply with the order of the Board of Trade. He had to decide between the two lots of witnesses as a jury would decide, and he preferred the evidence of the witnesses for the plaintiff rather than those for the defendants. With regard to the counterclaim, he had come to the conclusion that £500 should be awarded to the defendants. The plaintiff, however, should succeed on the claim for £7,401, and was entitled to damages for not having had an opportunity of finishing the work. These damages should be £5,000.

Mr. Rufus Isaacs, K.C., said this would mean that the plaintiff would have £12,401?

His Lordship: Yes.

No order was made as to costs.

Automatic Telephone Co. (1903), Ltd. (Petition of H. Le Blanc Smith and others.)

This matter was before Mr. Justice Byrne in the Winding-up Court on Tuesday, on a petition for winding up the company, and in the result, his Lordship, in giving judgment, said he was satisfied that there were many things in connection with the company which required investigation, and that there would be no satisfactory winding up except under the jurisdiction of the Court. It was exactly one of those cases where everything pointed to the necessity for a compulsory order. He accordingly made a compulsory order.

BUSINESS NOTES.

The Frongoch Mine Plant.—The attention of our readers is called to an unusually important and interesting sale of modern electrical mining plant, which Mr. Geo. N. Dixon, auctioneer, of Liverpool, has been instructed to sell by auction at the Frongoch Mines, near Aberystwyth, on April 11th to 15th. This sale will be of great importance to all colliery and mining engineers, and is worth special attention, inasmuch as the whole of the plant, which has cost upwards of £68,000, is to be sold without reserve, and, we are advised, affords to users a special opportunity of acquiring machinery of this description on terms that are seldom to be met with.

Reduction of Capital.—A petition for reducing the capital of the Blackpool Electric Tramways (South), Ltd., from £350,000 (£250,000 issued) to £100,000 by striking off £150,000, which has been lost or is unrepresented by available assets, is to be heard at Liverpool on March 21st.

Hippodrome Installations.—Messrs. Walker and Hodgetts, Ltd., have received a contract for the supply of 110-volt dynamos for lighting and power purposes at the Hippodromes, Salford and Harpurhey.

Imports of Foreign Electrical Machinery.—The value of the foreign electrical machinery imported into this country during February last amounted to only £48,967, bringing up the total for the first two months of the year to £95,904, as contrasted with £127,801 in the corresponding two months of 1903.

Tramway Point Controllers.—Messrs. S. Dixon and Son, Ltd., have received from the Bradford Corporation an order for the installation of Turner's patent point controller on its tramway system.

British "Tubes" for America.—According to the daily press, the Pennsylvania Railroad Co. has awarded the contract for the construction of the four East River tunnels, from New York to Long Island, to the firm of Pearson & Son, Ltd., of London. The New York contractors have been given the contract for the two Hudson River tunnels.

Electrical Wares Exported.

Week ending Mar. 17th, 1903.		Week ending Mar. 15th, 1904.	
Adelaide. Teleg. cable	Value £89,400	Adelaide	Value £90
Alexandria	68	Alexandria	143
Amsterdam	121	Amsterdam	137
Antwerp	23	Auckland	478
Bombay	315	Bombay	94
,, Teleg. cable	101	Brisbane	50
Brisbane	761	Buenos Ayres	228
Buenos Ayres	140	Calcutta	518
,, Teleg. mat. ..	1,428	,, Teleg. mat.	200
Calcutta	1,000	Cape Town	883
Cape Town	701	Colombo	88
,, Teleg. mat.	2,080	,, Teleg. mat.	123
Chinde. Teleg. appar. ..	410	Delagoa Bay	1,458
Durban	269	Durban	408
,, Teleg. mat.	1,926	,, Teleg. mat.	2,074
East London	1,183	East London	968
,, Teleg. mat. ..	625	Fremantle	170
Gibraltar	252	Gibraltar	60
Hamburg	37	,, Elec. machinery ..	3,000
,, Teleg. cable	100	Gothenburg	61
Karachi	39	Hamburg	134
Labuan	129	Hong Kong	26
Melbourne. Teleg. mat. ..	2,192	,, Teleg. mat.	850
Otago	311	Karachi	103
Paris. Elec. brougham	300	Madras	92
Perth	186	Melbourne	92
Singapore. Teleg. mat.	..110,640	,, Teleg. mat. ..	31
Sydney	395	Otago. Teleph. cable ..	733
Wellington	15	Paris	400
Yokohama	389	Perth	148
		,, Teleg. mat.	79
		Rio Janeiro	30
		,, Teleg. mat. ..	516
		Seville. Teleg. apparatus ..	26
		Shanghai	1,030
		,, Teleg. mat.	60
		Singapore. Teleg. mat. ..	690
		Smyrna. Teleg. mat.	23
		Sydney	441
		,, Teleg. mat.	125
		Tokio	82
		Wellington	79
		,, Teleg. mat	69
		,, Teleph. mat. ..	1,790
		Yokohama	132
Total ..	£215,586	Total ..	£19,062

Foreign Goods Transhipped.

Genoa. Elec. goods ..	Value £25	Boulogne. Elec. mat.	Value £80
Gothenburg. Elec. apparatus ..	25	East London. Elec. mat. ..	75
		Lyttelton. Elec. mat.	13
		New York. Teleph. mat. ..	198
		Singapore. Elec. apparatus ..	18
Total	£50	Total	£384

Belliss Engine Contracts.—Messrs. Belliss & Morcom have lately secured the following contracts:—

Edinburgh.—By Messrs. Dick, Kerr & Co., Ltd., for one 1,200-h.p. engine for direct coupling to English Electric Manufacturing Co.'s continuous current dynamo.

Belfast.—By Messrs. Mather & Platt, Ltd., one 585–781-h.p. engine for direct coupling to Mather & Platt 400-kw. alternator.

H.M. Dockyards.—By Messrs. Preece & Cardew, 15 engines, 865—1,080 h.p., for direct coupling to continuous current dynamos, six of which are for Chatham, five for Portsmouth, and four for Devonport.

Brush Car Contracts.—The Brush Electrical Engineering Co. have secured the following contracts:—

Leeds Corporation.—25 complete tramcars with Brush trucks and B.T.H. equipments.

British Thomson-Houston Co.—10 car bodies and trucks for Lanark Tramways.

"Gutta Gentzsch."—With reference to the translation from the official communication from the Imperial Post Office of Germany, respecting the "Gutta Gentzsch" submarine cable laid by the Government, which we published in our last issue, the article in question appeared in the February number of the *Archiv für Post und Telegraphie* of this year, so that the statement that no complaints of any kind have been received as to the working of these cables is made as a result of observations up to the present time. Owing to the allusion in the text to a copy of the *Archiv* for the year 1902, some of our readers appear to have formed the idea that the article appeared on that date.

Correction.—The following letter has come to hand too late for insertion in our "Correspondence" columns:—

"Our attention has been called to certain misleading advertisements and paragraphs which state, or imply, that the sale of the 'goodwill' of the Stewart Electrical Syndicate, Ltd. (in liquidation), carried with it rights in the Stewart arc lamp.

"As these statements are calculated not only to do us serious injury, but to mislead the public in regard to the channels through which these lamps can be obtained, we shall be grateful if you will allow us to state that some weeks prior to the sale we acquired the sole rights in the Stewart arc lamps, and that no firm is entitled to make or sell Stewart arc lamps not supplied by the original makers, or by our agents and customers or ourselves.

"Orders for lamps, spare parts and repairs are being executed promptly on receipt.

"*For* J. Defries & Sons, Ltd.,
"Wolf Defries, *Managing Director*."

Bankruptcy Proceedings.—A meeting of the creditors of Samuel Henry Thompson and James Edgar Thompson, of 8, Devon Terrace, Plymouth, trading as electricians at 6, East Street, Plymouth, under the style of Thompson Bros. & Co., was held last week at the offices of the Official Receiver (Mr. T. H. Geake), who presided. The debtors' statement of affairs showed that the gross liabilities were £366 9s. 5d., all of which were expected to rank, due to 51 unsecured creditors. There were also three creditors for £85 10s. under apprenticeship indentures, and one creditor for £1 12s. 4d. for rates. Deducting these latter sums, the debtors estimated their assets at £101 6s. 3d., leaving a deficiency of £235 3s. 2d. The principal items in the assets were £60 stock, £60 gas engine and dynamo, and £44 8s. 6d. book debts. The debtors subsequently came up for public examination before Mr. Registrar McCrea, at the Stonehouse Bankruptcy Court. Replying to the Official Receiver, the elder debtor, Samuel Thompson, said that he and his brother had been carrying on business since last July. The only capital they had of their own was £5. A month after they started they borrowed £50. They did a considerable amount of business, and made it pay all right until they took on a manager. They knew now that their arrangements with the manager had been unduly liberal. The manager had canvassed for orders and had quoted prices, and they had paid him a commission of 15 per cent. on the orders, irrespective of whether it paid to execute them or not. They had since found that the manager quoted one price to customers and another to them, so that the bills were disputed by the customers when they sent them in. The Official Receiver said the reasons for the failure were palpable. Two very young men had started business with practically no capital, and latterly they had been handicapped by making arrangements with a representative which were entirely for that representative's benefit, and against their own interests. The examination was closed.

The public examination of A. F. Gibb, who has carried on business at Cuxton Road, Strood (Rochester), as a plumber and electrical fitter, &c., took place at the Rochester County Court on Monday, before Mr. Registrar Smith. The gross liabilities scheduled amounted to £333 18s. 7d., and there was a deficiency according to the debtor's statement of accounts of £251 11s. 7d. Debtor made an arrangement with his creditors in August of 1901, and then paid 6s. 8d. in the £ on debts of some £380, and a part of the money for the composition was guaranteed by a creditor in this present bankruptcy, to whom a sum of £50 is due. The debtor was examined at length by the Official Receiver as to his affairs generally. The causes of his failure were given as bad trade and matters in connection with the settlement of debts under the scheme of composition. He admitted that he had done a little shooting with the keepers on the estate of the Earl of Darnley, at Cobham, and that a few days prior to his bankruptcy he ordered a shooting jacket of one of his creditors. The debtor was allowed to pass subject to signing notes.

Dissolutions and Liquidations.—The Tramways and General Appliances Co., Ltd., meeting at Walsall on March 8th, resolved upon voluntary liquidation, with Mr. H. C. Lewis, of Birmingham, as liquidator.

A meeting of Electrophone, Ltd., will be held at Telephone House, E.C., on April 13th, to hear an account of the liquidation.

Switchboard Contracts.—Messrs. Cowans, Ltd, of Salford, have just booked the following contracts:—

Shanghai Municipality.—Extension to main switchboard, and standard high-tension oil-break main switches controlling 4,500 kw. (£668 10s.).

Brighton Corporation.—Two heavy current disconnecting plug switchboards (£429).

Hastings.—Extension order for Andrews duplicate mains system (£126).

Book Notices.—"Die Elektrische Bühnen und Effekt-Beleuchtung," by Dr. Th. Weil. K. 4 h. 40. "Wechselstromtechnik," in four parts, by M. T. Zsakula. K. 4 h. 40 each. Vienna: A. Hartleben.

"Refuse Disposal and Power Production," by W. F. Goodrich. Westminster: Archibald Constable & Co., Ltd. 16s. net.

"Twenty-ninth Annual Report of the Yorkshire College, Leeds," 1902-3.

"Logarithms for Beginners," by C. N. Pickworth. London: Whittaker & Co. 1s.

Witton Motors.—The General Electric Co., Ltd., have issued a pamphlet dealing with these small motors which are now made at their Witton works, near Birmingham. The company have previously confined all the information regarding motors and dynamos to their plant catalogue, but owing to the increasing demand for small motors up to 10 h.p., this pamphlet has been issued separately. It details a complete range of standard motors from 1 to 10 h.p. at moderate speeds for all voltages ranging from 100 to 500 volts, which can be supplied in either open or semi-enclosed type. A large stock of all sizes is held at the works.

Smoke Nuisance.—The British Westinghouse Co. were, on 10th inst., fined 10s. and costs, for not complying with an order to abate a smoke nuisance at their works.

Coal Screening Plant.—We learn Messrs. J. & J. Charlesworth, colliery proprietors, Wakefield, have placed an order for a complete coal screening plant, including the whole of the steel structural buildings, roofing, picking belts, tipplers, &c., having a capacity of 3,000 tons per day, with Messrs. Graham, Morton & Co., Ltd. This plant is for their Kilnhurst pit, Rotherham.

Colliery Plant.—The British Westinghouse Co. have booked a large order from the Gwendreath Valleys Anthracite Co., including supply and erection of generating plant, with all accessories and numerous motors. The plant will be on the three-phase system and have a capacity of 200 kw.; the motors will be all of the makers' polyphase induction type. They will be utilised to drive pumps, a 100-h.p. main and tail haulage, and a Waddle fan with a capacity of 50,000 cb. ft. per minute, &c. A Belliss compound two-crank engine will be utilised to drive the generator.

Catalogues and Lists.—Some lists have been received from the Sir Hiram Maxim Electrical and Engineering Co., illustrating some of the company's special lines, including patent lampholders, shade carriers, patent locking devices for preventing the removal of lamps, semi-enclosed arc lamps, and incandescent lamps.

A finely illustrated circular issued by Messrs. Davidson & Co., Ltd., describes the "Sirocco" centrifugal fans.

Messrs. Vandam, Marsh & Co., Ltd., of Soho, are circulating a list giving a full description, with detailed illustrations and diagrams, of their "Cantie" quick-break switch.

Mr. Ernest Roberts, of 6, Holborn Place, W.C., has sent us a price list of various lampholders, also distributing fuseboards, of which cuts are shown.

Messrs. Bray, Markham & Reiss, Ltd., of Walthamstow, have issued a new price list (sheet 8) of their B.M.R. patent resistance tubes.

A 42-page catalogue of alternating-current machinery for lighting, power and railway service has come to hand from the National Electric Co., of Milwaukee, U.S.A.

Messrs. Hodgson Wright & Wood, of Halifax, have just brought out a new price list (No. 11) of open-type dynamos, the special features of which are claimed to be sound design, high-class mechanical construction, high efficiency, and slow speeds. The firm's new factory is just on the point of completion. These extensions will enable the firm to turn out large quantities.

The Mid-British Co., of Congreaves Works, Cradley Heath, have sent us an illustrated circular relating to their special cable screw jacks, pulley blocks, and hoisting crabs for drawing in cables.

The Electric and Ordnance Accessories Co., Ltd., have issued leaflet B 52 as an addition to their catalogue. It deals with their various types of inter-communication telephones for which the principal claims are the common battery, the neatness, an improved hand set, and low price. Copies of the list (12 pp.), which is well illustrated and has the prices clearly shown, will be sent to the trade on application.

Trade Announcements. — In addition to the new appointments which Messrs. G. Straus & Co, of 211, Upper Thames Street, E.C., have made, as announced last week, the firm have taken additional warehouse premises at 1, Hatchet Court, Upper Thames Street, E.C. Messrs. Straus have also taken up other important agencies, and they now represent the following manufacturers:—Dr. Cassirer & Co. (electric lighting cables), who have lately largely increased their works and have added special machinery for the making of silk and cotton-covered wires for scientific instruments, &c. Messrs. Lindner & Co. (Jecha, Sondershausen), who make all kinds of china goods, such as ceiling roses, counterweights, oblong and bow cut-outs, wall plugs, adapters, &c. Messrs. A. Grothe & Sons, Cologne, manufacturers of distribution fuseboards, electric bells, indicators, brass-bell pushes, &c.; and the Aix-La-Chapelle Steel Works, Aix-La-Chapelle, makers of petrol engines, change-speed gears, differential axles, &c. Messrs. Straus hold a stock of all these manufactures in London. They have a full catalogue prepared, and copies will be issued very shortly.

Messrs. Monté-Callow & Co., of Ludgate Broadway, E.C., report that, owing to the large business which they are doing in their Perfecta starters, regulators and controllers, it has been found necessary to more than double the size of the works. The addition of the most modern plant, facilitating a greatly increased output, has enabled them to revise their prices. A new price list is in course of preparation.

The Bergmann Electrical Works have removed from Farringdon Avenue to 6, Victoria Avenue, Bishopsgate Street Without, E.C.

The Birmingham Electrical Fittings Co. have now removed to their new premises at Baskerville Place, Broad Street, Birmingham, and all communications should be addressed there in future. The plant and machinery have been considerably increased.

We understand that Mr. H. A. Casperd, late of the General Electric Co., and Mr. G. C. Maudslay, late of the London United Electric Tramways, have entered into partnership and are starting business as Electrical and General Engineers, at 16, Silsdon Road, Croydon, where they will be glad to receive catalogues, &c.

Messrs. Julius Sax & Co., Ltd., are moving their offices and stores to Nos. 10 and 11, Great Newport Street, W.C., as from 21st inst., and as a consequence they are disposing at low prices of surplus stock, which is not now covered by their catalogue and lists. In the new premises the firm expect to be in a better position to give prompt delivery.

The St. Helens Cable Co., Ltd., have opened premises at 93, Hope Street, Glasgow, where large stocks of cable and rubber goods are held. Mr. W. M. Davidson is the company's representative there.

LIGHTING AND POWER NOTES.

Ashford (Kent).—The U.D.C. has resolved to make an agreement with a company which has undertaken to supply the town with electricity, enabling the Council to purchase the undertaking after twenty-one years.

Aston.—The Electricity Committee of the T.C. has recommended the Corporation to apply for a loan of £30,000 for the extension of the plant at the electricity works. The additions are:—One 750-kw. steam dynamo, £8,000; two water-tube boilers, mechanical stokers and superheaters, £3,200; extension of coal bunker and conveyor, £1,500; ejector-condenser, pipework, circulating tank, &c., £1,500; steam piping, £1,050; new generator panel on switchboard, and cables to steam dynamo, £650; extension to existing mains, and 200 extra services, motors and time switches, £5,600; building extensions, £8,500.

Bangalore.—An Indian correspondent, writing to *Commercial Intelligence*, states that there seems to be an impression that the electric lighting scheme has been carried out by, and that the fresh scheme which has been sanctioned will be put through by, a British company. "As this is by no means the case, it is only right that your readers should know that practically all the electrical equipment was obtained from American manufacturers. . . .

"The above is interesting as illustrating the tendency, which is everywhere manifest, for foreign firms to masquerade wherever possible as English manufacturers, especially in view of the outcry which has been raised against the purchase of foreign material by the Indian Government, with the unsatisfactory results so often reported in your columns."

Beckenham.—The U.D.C. has resolved to accept the terms of Mr. R. P. Wilson to carry through the transfer of the Crystal Palace Co.'s supply to Beckenham and to act as consulting engineer for the extension of the plant and machinery for tramway purposes.

Bendigo.—A start has been made in the introduction of electricity for motive power at the Bendigo gold mines, where there is a splendid field for development.

Birstall.—The U.D.C. has decided to make inquiries from power users and residents of the district as to their desire to be supplied with electricity.

Blackpool.—A L.G.B. inquiry was held recently into the application of the U.D.C. for a loan of £3,700, for the provision of a new traction set at the E.L. works; there was no opposition.

Eastbourne.—The T.C. has applied for a loan of £3,221, for the provision of condensing plant at the electricity works.

Germany.—A municipal electricity works is to be established in the town of Alme.

Glasgow.—The E.L. Committee has recommended the Corporation to authorise the treasurer to repay to the gas department the sum of £13,895, being the deficit on the operations for the year ending May 31st, 1903, which was transferred to the gas account. The large deficit referred to arose in very exceptional circumstances. While the machinery in the original station in Waterloo Street was not antiquated, the plant was too small to be of practical use in dealing with the great increase of supply which had devolved upon the department. It was therefore found to be more profitable to remove that plant and supply from the new station, Port Dundas. The abolition of the Waterloo Street machinery involved a loss of about £8,000. Further, the change from the lower voltage of 100 to the higher one of 250 cost the Committee during the three years which ended last May the large sum of £20,000. With very few exceptions the change is now complete to the higher voltage.

The report has been issued of the special sub-committee dealing with the question of street lighting, in connection with which a deputation visited various English towns. From it we gather that Leeds possesses 110 10-ampere D.C. arc lamps, supplied free with energy by the tramways department, and 121 enclosed 5 and 6-ampere A.C. arc lamps, the latter consuming 400 and 500 watts respectively. The smaller lamps cost £4 7s. 9d. per lamp per annum for half-night burning, and £8 7s. 2d. for all-night burning, the street lighting department owning the lamps and maintaining them. At Bradford only 52 D.C. arc lamps were found. The charges were at the rate of £12 10s. per lamp per annum, which includes maintenance and attendance; the lamps being the property of the E.L. department. At Liverpool 185 arcs are in use, and are erected and maintained by a street lighting staff. The cost per lamp is £15 per annum, burning till midnight. The committee also visited Sheffield, London and Brighton, finally deciding on the introduction of incandescent gas lighting in all streets in which gas is used.

Horsham.—The U.D.C. has approved an alteration in the scale of charges from 7d. and 5d., maximum demand, to 7d. and 3d. per unit; places of worship 5d. per unit flat rate; no charge will be made for the hire of meters.

Huddersfield.—The Electricity Committee has authorised the electrical engineer to proceed with the extension of the mains to Linthwaite. The statutory borrowing powers are to be exercised.

Jersey.—It has been decided to promote a Bill for electric lighting powers.

Johnstone.—The negotiations between the T.C. and the Clyde Valley Electric Power Co. have culminated in the T.C. deciding not to oppose the prov. order now before Parliament.

Kearsley.—At a recent meeting of the U.D.C., a letter was received from the B. of T. stating that consideration of the question of revoking the E.L. order would be deferred until the end of the year. The Council is in negotiation with Farnworth U.D.C., and several private companies with the object of transferring the order.

King's Lynn.—By 17 votes to 6 the T.C. has rejected a proposal to introduce gas lighting in certain streets, so as to avoid raising a loan of £11,500 for E.L. purposes. It was pointed out that whereas public lighting by electricity cost £1,687 per annum, gas would cost £1,836.

London.—Marylebone.—The application of the B.C. for sanction to add a new clause in the E.L. Bill to empower it to enter into working agreements with any company respecting execution, maintenance, and management of any works, was before the Examiners of the House of Commons on 11th inst.; no such agreement to be for a longer period than 10 years without the consent of the

B. of T. As this provision would be considered as one of the objects of the Bill, and was not included, nor any intention to apply for such powers stated in the Parliamentary notices, it was ruled that the Standing Orders had not been complied with. In regard to the application by the B.C. to the L.C.C. to advance, in the event of its Bill being passed, the sum of £1,365,000 for the purchase money and compensation payable to the M.E. Supply Co., the Finance Committee of the L.C.C. has recommended that the B.C. be informed that it is unable to accede to the request, but that it will entertain the proposal as soon as financial conditions are sufficiently favourable. A temporary arrangement for meeting the liability, either with the company or by obtaining powers from Parliament to borrow temporarily, is suggested.

Islington.—On the recommendation of its E.L. Committee, the B.C. has resolved to convert the mains in the High Street between Duncan and Torrens Streets from two to three-wire at a cost of £274, and a similar conversion about Northampton Park at a cost of £214. The engineer reported complaints from consumers that the pressure of supply was below standard, and, after investigation, it was found to be so.

Shoreditch.—The B.C. on Tuesday last, sanctioned the following estimates:—£450 for connecting up mains for the three-wire system to supply new consumers; £200 for 81 meters and 12 indicators. A letter was received from the B. of T. approving of the additional system of supply at a pressure of 240 and 480 volts. The clerk to the L.C.C. transmitted a resolution passed by that body consenting to the change of pressure subject to conditions.

Bethnal Green.—The Finance Committee of the B.C., on the 15th inst., submitted an estimate for £9,250 for the purchase of freehold and leasehold interests of property to be used as an additional site for electricity works and a refuse destructor.

Wandsworth.—A Board of Trade inquiry was held recently as to an appeal by the County of London and Brush E.L. Co. in respect to the conditions, subject to which the B.C. had approved the laying of electrical conduits on the Heaver Estate, Balham.

Lowestoft.—The T.C. has decided to expend £200 upon a store at the works, and has sanctioned a further extension of the public lighting.

The T.C. has fixed the price for energy supplied to the Corporation tramways at 2¾d. per unit. When the annual consumption reaches 250,000 units the charge is to be revised.

Luton.—The T.C. has decided that after April 1st the charges for energy for power shall be 2d. per unit for the first 1,000; 1½d. per unit for the second 1,000, and 1¼d. per unit after.

Lytham.—The U.D.C. has circularised the ratepayers on the E.L. question, asking them whether they are in favour of the order being carried out at an estimated cost of between £30,000 and £40,000, and whether they will take a supply.

Manchester.—The Electricity Committee is asking the City Council to sanction a rearrangement of the plant at the Dickinson Street station. The chief feature will be the substitution of two new turbine engines for the present engines, at a cost of £11,000. It is hoped by this means to remove the inconvenience caused in the neighbourhood of the works, through vibration from the existing machinery. The Committee has also approved of a recommendation by the electrical engineer (Mr. S. L. Pearce) that additional plant shall be provided at the sub-stations in order to meet the increasing demand for energy, for traction and other purposes.

Melbourne.—The conference of representatives of municipal councils and leading electric supply companies throughout the Commonwealth, convened for the purpose of considering the regulations recently drafted under the Federal Post and Telegraph Act, in their bearing upon the powers of electricity supplies, was concluded recently. The two sub-committees' reports dealing separately with the two divisions: Electric traction; and light and power lines or works, were adopted. The committees submitted that the Commonwealth Government had no right to interfere with the action of municipalities or other bodies controlling electric light and traction, or to frame regulations for their guidance, except such as were intended to prevent interference with the working of telegraphs and telephones.

Morpeth.—At the meeting of the T.C. on the 10th inst. the town clerk read a communication from the L.G.B. respecting the proposal of the Council to grant a lease of the site of the power station to the Northern Electricity Supply Co. for 99 years at an annual rental of £2 10s. The Board pointed out that it would only consent to the Council's application on the understanding that the lease was a short one, and that it could not consent to the leasing of land below its market value, which, in this case, had been fixed at £6 per annum. A copy of a petition which had been sent to the Board by property owners and others, complaining of noise and vibration from the power station, and smoke nuisance, was also read, asking the Board to withhold its sanction to the Council's proposal, and to compel it to have the station removed to a more suitable place. The company, it is stated, is willing to pay £6 per annum for a 99 years' lease. It was resolved that the L.G.B. be supplied with the Council's reasons for a 99 years' lease, and informed that £6 a year would be paid, and that the nuisances complained of would be abated.

Northampton.—The B. of T. has recommended the R.D.C. to confer with the Northampton Electric Light and Power Co., with a view to coming to some agreement regarding the proposed extension of the E.L. mains into the R.D.C.'s district, and the suggestion has been adopted by the Council.

Plymouth.—The T.C. has applied for a loan of £20,000 for E.L. purposes.

Preesall.—The U.D.C. has requested Mr. Hansom, of Fleetwood, to submit proposals for a scheme of E.L. for the district.

St. Annes.—The U.D.C. announces that it will reduce the rate for public lighting from 3½d. to 2½d. per unit, and abolish meter rents.

Soothill Upper.—Arrangements have been arrived at whereby the Yorkshire Electric Power Co. will withdraw their opposition to the U.D.C.'s Tramway Bill on the Council eliminating from the Bill powers to supply energy outside the district.

Whitby.—The U.D.C. has decided to apply to the L.G.B. for sanction to a loan of £3,000 for mains extensions, and to enter into an agreement with the G.E. Co. for supplying motors on the hire system, the Council to collect the rents. The Council has also resolved to give an honorarium of £25 to its electrical engineer, Mr. L. H. King, in lieu of granting a permanent increase of salary.

Whitehaven.—The T.C. has arranged to supply energy to the Harbour Commission for lighting purposes at 3½d. per unit for three years. The Council will lay mains, &c., at a cost of £200. Mains have also been laid to the workhouse at a cost of £1,090.

TRAMWAY AND RAILWAY NOTES.

Ayr.—It has been remitted to the Tramways Committee of the T.C. to take steps, if thought advisable, to procure a provisional order for the purpose (1) of increasing the borrowing powers of the department by £40,000; (2) doubling the line on the south side from the Grammar School to Chapel Park; (3) extending the line on the north to the village of Monkton. It has also been agreed to fix three halfpenny stations in the Priestwick area. Hitherto there have been no halfpenny stations outside Ayr burgh.

Berlin Elevated Railway.—The combined elevated and underground electric railway in Berlin has now been in operation for two years, and is therefore beginning to show what it can accomplish from a financial point of view. During the first year the line was worked and maintained by the contractors, who had agreed to pay interest on the company's share capital to the extent of 4 per cent. This rate was paid, although the contractors refrained from giving any information as to the financial results of working during the guarantee period. It is now announced that the operations of the railway under the company's first year—that is, the second year since the line was opened—will allow of the payment of a dividend at the rate of 3½ per cent.—*Financial Times.*

Bristol.—The question of overcrowding the electric cars continues to excite attention. There have been no fewer than 90 summonses of this description against the Tramway Co. since the meeting of the Church Congress.

Fremantle (W.A.).—Agreement has now been attained between the municipalities of Fremantle and East Fremantle respecting the tramway and lighting services, and it has been decided to raise a loan of £100,000 to carry out the work.

Glasgow.—A return is to be made of all accidents that have taken place on the Corporation tramways for a year.

Huddersfield.—The Corporation tramways are gradually making headway, an increase in the receipts having been reported for the last few months. During February the traffic receipts amounted to £4,441, equal to 8·41d. per car-mile, an increase of £356 on the corresponding month of last year.

Ilford.—The U.D.C. has applied to the B. of T. for a loan of £20,500 to cover the sum spent in excess of loans on the construction of the electric tramways.

L. & Y. Railway.—An official trial run on the electrified line of the L. & Y. Railway between Liverpool and Southport, has been arranged to take place on the 22nd inst. A party of representatives of the company and contractors and of experts will accompany the train, which will leave Liverpool at 11.35 a.m. On the return journey a stop will be made at Formby, for an inspection of the generating station. The party will then return to Liverpool, where luncheon will be served at the Exchange Station Hotel.

Manchester.—The contribution this year by the tramways department in relief of the city rates, will be £50,000. This is the sum which the Tramways Committee has agreed to set aside for the purpose, after meeting depreciation and all other charges. Last year, before the whole of the tramway system was in operation, a sum of £30,000 was voted by the Committee.

Perth (W.A.).—The City Council has decided to drop the proposed action against the Perth Electric Tramways, on condition that the Council receive 3 per cent. on all fares collected for journeys, or parts of journeys, entirely within the City boundaries, and licence fees of 1s. per car and per driver per annum, with other conditions relating to the fares charged.

Power Signalling on the N.E. Railway.—It was decided at a recent meeting of directors of the North-Eastern Railway Co., at York, that an extensive installation of Westinghouse power signalling should be installed at the new Paragon Station, Hull, and the contract was let to Messrs. Mackenzie and Holland, the agents of the Westinghouse Brake Co. The apparatus will be of British manufacture, being made at the works of the Westinghouse Brake Co., at King's Cross.

Southampton.—The Corporation Tramway Committee reports that the assessment of the tramway undertaking has been reduced from £2,284 to £1,324.

Walsall.—A detailed account, showing the actual cost of the construction of the permanent way of the tramways extensions and the reconstruction of part of the old lines, has been submitted to the Tramways Committee by the borough surveyor, who therein sets the cost down at £73,033. The electrical engineer has reported that the electrical equipment of the lines and the re-equipment of part of the old lines has amounted to £34,557. The Committee has issued a statement of the working of the tramways since they were opened to traffic. The total capital outlay in respect of the tramways undertaking up to the 7th inst., reached £126,193, of which £114,906 had been paid, leaving a sum of £11,827 owing to the contractors, and others. In addition to the above expenditure, there has been allocated, out of the money authorised to be borrowed for tramway purposes, £20,000 to cover expenditure incurred by the electricity department in connection with the supply of energy to the tramway. It may be added that the lines from Milton Street to the Bridge and from Wisemore to Green Lane, Bloxwich, are to be re-equipped electrically at an estimated cost of £2,600; whilst for the purpose of extending the Birchills tramway depôt additional land is to be acquired at a cost of £450.

West Bromwich.—On the 8th inst. Col. Yorke made a Board of Trade inspection of the 2½ miles of tramways reconstructed down Spon Lane and Bromford Lane in order to connect the West Bromwich system with the Oldbury and Smethwick trams. These lines will form junctions at the Market Place, Oldbury, and Spon Croft, West Smethwick, with the electric system of tramways between Dudley and Birmingham. The new lines, it may be added, complete the tramway scheme of the Corporation. Col. Yorke intimated that the cars could commence running as soon as convenient, and the service was accordingly commenced the same night.

Worcester.—Owing to delay in completing the tramways, the tramway company has been unable to take the 200,000 units of energy from the Corporation, and the T.C. has decided to issue a writ against the company for £1,666 13s. 4d. due for that amount of energy.

TELEGRAPH AND TELEPHONE NOTES.

Buenos Ayres.—The *Standard* of that city draws attention to the great danger which the inhabitants run from the present arrangement of installing telephone wires over the numerous trolley tramways. It is suggested that the latter system should not have been permitted in the city, and that steps should immediately be taken to provide effective safeguards. The Municipality, however, indirectly discourages the placing of the telephone cables underground by imposing fines for opening up squares, streets, &c., which would amount in the aggregate to a large sum. The Union Telefónica has expended over £100,000 during the past five years in new switchboards and plant, including the introduction of metallic circuits. The general rate per year at Buenos Ayres is $180 m/n., at London, £17—$195 m/n., New York, $183 gold—$480 m/n.—the number of subscribers in each case being 9,000, 30,000 and 120,000.

Exports of Telegraph Cables and Apparatus.—Returns just issued show that the value of the telegraph cables and apparatus exported from this country during February last amounted to £39,645, bringing up the total for the first two months of the year to £216,795, as compared with only £110,753 in the corresponding two months of 1903.

The C.S. "Scotia."—Press despatches from New York state that the *Scotia* (T.C. and M. Co.'s cable steamer, which has been engaged in laying the Commercial Cable Co.'s new Pacific cable) has been wrecked on the Spanish Rocks, off the Island of Guam, in the Pacific. The vessel is likely to become a total wreck.

Guernsey Telephones.—Many of the newspapers and financial organs have, during the past week, quoted extracts from the report of the Guernsey States Telephone Department for 1903, the sixth year of working. From these we gather that the report shows the number of instruments working at December 31st last (exclusive of junction lines) to be 1,217, or one telephone to every 33 of the population of the island. "Capital expenditure on telephone construction has amounted to £21,262. In addition to the cost of construction, £2,322 has been expended on purchase of land and erection of buildings, as the interest on money so invested is considerably less than the annual rent cost of similar buildings taken on lease. The cost per line works out at £17 9s. 5d., and in addition to the 1,217 working lines, there were, at December 31st, 1903, several hundred spare partially-completed lines. If the value of these were deducted from the cost of construction, the cost of the working lines would be considerably less than the amount stated above. The total revenue for the year was £4,064, and the average revenue per line per year, £3 6s. 9½d. There has been set aside out of revenue for capital sinking fund and depreciation, after paying interest, Post Office royalty and all working expenses, £3,830, and set aside out of revenue for special contingency fund £397. The net profit for 1903 was £201."

Post Office Telephones.—In reply to a question in the House of Commons last Monday, Lord Stanley stated that it was intended to continue the use of the central battery system for Post Office telephone exchanges in London. It had given excellent results, being both efficient and economical. He was not aware that this system had not found favour in other countries. On the contrary, he was informed that it was generally adopted for large exchanges in America, and it was either already in use or about to be introduced at important exchanges in several European States.

Rio de Janeiro Telephones.—The *South American Journal* says that the German Electricity Co., which works the telephone service in Rio city, realised 378,335 M. net profits in 1903, and distributed 5 per cent. on its nominal capital, one half paid up.

State-Owned Telegraphs.—The Associated Chambers of Commerce at their meeting in London last week resolved, on the motion of Sir E. Sassoon, M.P., and Lord Brassey:—"That in the opinion of the association all the self-governing British communities around the globe should be united by a continuous chain of State-owned telegraphs."

Swansea.—At a meeting of the Telephone Committee, the question of inter-communication with the National Co.'s subscribers was brought up last week. Inter-communication had been granted by the Postmaster-General on the representations of the Corporation as to the number of subscribers they had on their system, and the proportion they bore to the National subscribers. The National Telephone Co. now wrote making a request for an examination of the books, contending that the Corporation committee's assurance respecting the number of its subscribers was not acceptable. They further raised the question that the order would only apply to the local area and not to their systems in other towns. The Committee decided that it would not discuss the communication, and that the inter-communication must apply to all areas.

Subsequently the vice-chairman complained that although it was understood at the last meeting of the Council that a complete estimate of the financial position of the system was to be drawn up to March 31st, he now found that the report was being prepared up to February 29th. He accused the chairman (Mr. Solomon) of varying the instructions on his own authority.

Mr. Solomon contradicted this, and after inquiry, said that there was no room for the manager of the Telephone Department and himself. It was clear to him that the manager was going to deliberately run counter to him, and he would tender his resignation.

Telegraphic Interruptions and Repairs:—

Cables,		Interrupted,	Repaired,
Dominica-Martinique		May 5, 1902	
St. Lucia-Martinique		May 7, 1902	
Trinidad-Demerara No. 1		Aug. 27, 1901	
Cayenne-Pinheiro		Aug. 18, 1902	
New York-Hayti		April 18, 1903	
Anjer-Kalianda		Aug. 2, 1902	
Reissa-Issa (Yemen)-Camaran		Oct. 22, 1902	
Tourane-Amoy		Nov. 10, 1903	
Tarifa-Tangier		Jan. 18, 1904	
Oran-Tangier		Feb. 3, 1904	March 11
St. Jacques-Haiphong		March 7, 1904	
Mole St. Nicolas-Cape Haiti		March 11, 1904	March 14
Closed: Nagasaki-Vladivostock		Feb. 15, 1904	
Closed: Port Arthur-Chefu		Feb. 18, 1904	
Landlines.			
Seoul-Masampo		Feb. 13, 1904	
Seoul-Gensan		Feb. 13, 1904	
Anju-Ping-Yang		Feb. 25, 1904	
Ninguta-Vladivostock		March 2, 1904	
Saigon-Bangkok		March 12, 1904	March 13

Who Knows?—Messrs. Stegmann & Co., of Clapham Junction, write:—"May we ask if you could enlighten us why Crouch End is without the telephone; there is neither the National nor the Post Office system in use, the town being without any communication whatever."

Coal-cutting Machinery.—Before the Glasgow Section of the Institution of Electrical Engineers on 8th inst., Mr. Sam Mavor delivered an address on "Electrical Coal-cutting Machinery." He said that the number of coal-cutting machines in use in America was between 3,000 and 4,000, whereas the number in use in the United Kingdom was only between 300 and 400. The output of coal per man in the United States was nearly double that in this country. This difference was due, in part, to the fact that American seams of coal were thicker than those in the United Kingdom, and the coal was therefore more easily won. The difference was also partly due, no doubt, to the very large increase in the number of mechanical coal-cutters used in the United States within recent years. The question of mechanical coal-cutting was now, however, exciting lively interest on the part of British mining engineers, and the number of machines in use was very rapidly increasing.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 31st. Two water-tube boilers and accessories. See "Official Notices" March 11th.

Austria.—March 20th. The Municipal Authorities of Retz are inviting tenders until March 20th for the establishment of a central electric lighting station in the town.

Birmingham.—March 30th. The Handsworth U.D.C. invites tenders for contract No. 1 (Holyhead Road)—permanent way, paving and road work and overhead equipment. See "Official Notices" March 11th.

Canary Islands.—March 23rd. Electric tramway between San Cristobal de la Laguna and Tacoronte (Canaries). See this column for February 19th.

Chili.—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

Dartford.—March 26th. The U.D.C. invites offers for constructing and working light electric railways. See "Official Notices" to-day.

Dundee.—March 26th. Electricity meters. See "Official Notices" to-day.

Edinburgh.—April 4th. Electricity meters for the Corporation. See "Official Notices" to-day.

Ilford.—March 22nd. One 1,000-KW. steam dynamo, switchboard work, condensing plant, water purifying plant, pipework, cables, &c. See "Official Notices" February 26th.

Ipswich.—March 22nd. Electric lighting cables. See "Official Notices" to-day.

Keighley.—March 25th. Rails, overhead equipment, cars, cables, switchboard, car-sheds, &c., for the tramway scheme. See "Official Notices" March 11th.

Lancaster.—April 14th. Permanent way, overhead trolley and other tramway work. See "Official Notices" to-day.

Lincoln.—March 21st. Water-tube boiler, engine and dynamo. See "Official Notices" March 4th.

Manchester.—April 7th. Synchronous motor-generators for sub-stations; superheaters for Dickinson Street. See "Official Notices" to-day.

Melbourne.—May 13th. One 750-KW. direct-current steam generator. See "Official Notices" to-day.

Metropolitan Asylums Board.—March 22nd. Fire alarms and telephones, at Leavesden Asylum. See "Official Notices" March 4th.

Natal.—May 9th. Electric telpherage system for Bonded Warehouse. See "Official Notices" to-day.

Newport (Mon.).—March 21st. Boosters, balancers, switchboards, tramway poles, overhead work, section pillars, cables, and trolley wire for the Corporation. See "Official Notices" March 4th.

Poplar.—March 26th. Three-phase motor-generators, switchboards and cranes. See "Official Notices" to-day.

Reading.—April 2nd. Six double-deck bogie cars, and one water cart. See "Official Notices" to-day.

St. Anne's.—March 26th. Condensing plant and cooling tower. See "Official Notices" March 11th.

Salford.—March 19th. Electric fittings, lamps (arc and incandescent), cables, pipes, &c. See "Official Notices" March 4th.

Spain.—March 20th. The establishment and working during a period of 20 years, of a telephone exchange in the town of Figueras. See this column for February 26th.

Spain.—March 21st. Electric tramways in the town of Seville. See this column for February 19th.

Spain.—March 28th. Tenders for the lighting of the town of Plasencia.

Spain.—March 28th. The Spanish Post and Telegraph Authorities are inviting tenders for the establishment of a telephone line between Gijon and Pola de Siero, *viâ* Granda and La Collada. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correo y Telegrafos, Carretas, 10, Madrid.

Spain.—April 2nd. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until April 2nd for the establishment and working of a telephone exchange at San Lorenzo de El Escorial (Madrid province) with sub-exchanges at Cercedilla and San Rafael. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Stockport.—March 30th. One 500-KW. steam generator. See "Official Notices" March 11th.

Sunderland.—March 31st. India-rubber cables for a year. See "Official Notices" March 4th.

Swindon.—March 25th. Tramcar depôt lighting. See "Official Notices" March 11th.

Swindon.—March 31st. Water softener, 60-KW. motor-generator, switchgear, lamps, cables, oils and meters. See "Official Notices" March 11th.

Turkey.—Tenders are at present being invited for the supply and erection of the plant required for the electric lighting of the town of Damas. Particulars may be obtained from M. Noman Bey, 12, Rue du Pot d'Or, Liège, Belgium.

Westminster.—April 18th. High and low-pressure switchboards for the Westminster Electric Supply Corporation. See "Official Notices" to-day.

CLOSED.

Ashton-under-Lyne.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of motors for the ensuing year.

Aston.—The Corporation Electricity Committee has accepted the tenders of the General Electric Co., Ltd., Witton, for a 750-KW. generating set, £6,435.

Colne.—The Corporation has ordered a 400-KW. dynamo, direct-coupled to a Belliss engine, from Messrs. Bruce Peebles and Co.

Chatham Dockyard.—Messrs. Bruce Peebles & Co., Ltd., have received a contract from the Lords Commissioners of the Admiralty for:—Six 1,000-E H.P. direct-coupled generating sets, Belliss engines, condensers, &c.; four 100-H.P. balancers and boosters, and 4,000 H.P. in motors varying from 5 to 75-H.P., main switchboard, &c. This plant is for the complete electric equipment of the Dockyard.

Durham County.—The C.C. has accepted the tender of Messrs. C. A. Pearson & Co. for the installation of two 150-KW. E.L. plants, driven by steam turbines at the County Asylum at £5,192 10s.

Hornsey.—The T.C. has accepted the following tenders:—For water-tube boilers, Babcock & Wilcox, £3,025; for smoke-consuming apparatus, the Wilskemp Smoke Consumer Syndicate, £266 16s.; for engine house plant, the General Electric Co., £6,298 10s.

Islington.—The Lighting Committee has received seven tenders for the supply and laying of mains and cables during the ensuing 12 months. The acceptance of the tender of the British Insulated and Helsby Cables, Ltd., is recommended.

Fulham.—The B.C. has accepted tenders from the following for the supply of electrical stores during the ensuing year:—General Electric Co., Brush Co., the Vacuum Oil Co., W. H. Wilcox & Co., B.T.H. Co., W. Woods & Co., W. T. Thomson & Co., and the British Insulated & Helsby Cables, Ltd.

Maidstone.—The T.C. received the following tenders for wiring small houses:—

A. H. Woolley, 9 lights, £4 10s.; 8 lights, £3 17s. 6d.; 3 lights, £2 16s.
W. T. Burrows, 9 lights, £5 10s.; 8 lights, £4 7s. 6d.; 3 lights, £2 10s.
W. Cogger, 9 lights, £4 15s. 6d.; 8 lights, £3 17s. 6d.; 3 lights, £2 5s.
Haynes Bros., Ltd., 9 lights, £4 15s.; 8 lights, £3 10s.; 3 lights, £2.
T. King, 9 lights, £4 17s. 6d.; 8 lights, £3 13s.; 3 lights, £1 19s. 6d.
Morris, Jones & Co., 9 lights, £4; 8 lights, £3 3s.; 3 lights, £1 15s.
Stevens & Barker (accepted), 9 lights, £3 10; 8 lights, £3; 3 lights, £1 15s.

Newport (Mon.).—The Newport School Board have placed the contract for lighting St. Woolos Schools—recently advertised in our columns—with Messrs. A. G. Arnold & Co., of Newport. The new church of St. Luke's electric lighting has also been placed with the same firm.

Whitehaven.—The T.C. has accepted the tender of the Reason Manufacturing Co., Brighton, for a year's supply of fuse boxes; that of the Edison & Swan Co. and Messrs. Defries & Sons, for electric glow lamps; that of Ferranti, Ltd., for electricity meters; and that of Callender's Cable & Construction Co., Ltd., for joint box compound.

Wolverhampton.—The T.C. has accepted the tender of Callender's Cable Co. for the supply of feeders, distributors, pilot cables, conduits, service boxes and other materials required by the Electricity Department up to March 31st, 1905.

FORTHCOMING EVENTS.

Saturday, March 19th.—Institution of Electrical Engineers (Glasgow). Smoking Concert at the Grand Hotel.

Association of Engineers-in-Charge. Annual dinner.

At 7 p.m. Junior Institution of Engineers. Conversazione.

Monday, March 21st.—At 8 p.m. Society of Arts. "Recent Advances in Electro-Chemistry," by Mr. B. Blount. (Lecture III.)

Wednesday, March 23rd.—At 3.30 p.m. Institution of Electrical Engineers (Manchester) and the Liverpool Engineering Society. Visit to the Mersey Railway Works.

At 7.30 p.m. Paper on "The Design of Electrical Machinery," by Mr. J. L. Hunt.

Thursday, March 24th.—At 7.30 p.m. Institution of Electrical Engineers (Leeds). Meeting.

At 8 p.m. Institution of Electrical Engineers. "Direct Reading Measuring Instruments for Switchboard Use," by Mr. K. Edgcumbe and Mr. F. Punga.

Friday, March 25th.—At 5 p.m. Physical Society. Meeting.

At 7.30 p.m.—Institution of Electrical Engineers (Manchester Students). "Photometric Testing," by Mr. D. L. Sands.

At 7.30 p.m.—North-East Coast Institution of Engineers and Shipbuilders. "Automatic Governing of Marine Engines," by Mr. H. M. Wilson.

At 8 p.m. Institution of Civil Engineers (Students). "The Relative Advantages of Continuous and Alternating Current for Traction Purposes," by Mr. J. M. Kennedy.

At 9 p.m. Royal Institution. "Liquid Hydrogen Calorimetry," by Prof. Dewar.

Saturday, March 26th.—At 3 p.m. Royal Institution. "The Life and Work of Stokes," by Lord Rayleigh. (Lecture VI.)

NOTES.

Our Issue for Good Friday Week.—It is necessary that the issue of the ELECTRICAL REVIEW for April 1st (Good Friday) shall appear two days earlier than usual—Wednesday morning, March 30th. We shall be glad if our friends will take note of the following arrangements:—

Editorial Pages.—Correspondence must be in our hands by 10 a.m. on Monday, March 28th. Reports, notes, and all small editorial matter by 5 p.m. on the same day.

Advertisement Pages.—New copy and alterations to existing displayed advertisements by Saturday morning, March 26th; Official Notices and small prepaid advertisements can be received up to the morning of Tuesday, March 29th, the day before publication.

Electric Power on Cargo Steamers.—A paper was recently read by Mr. D. K. Roberts, M.I.E.E., before the Bristol Section of the Institution of Mechanical Engineers on the above subject. In the paper the author advocated the adoption of electric power on cargo steamers for driving all the auxiliary machinery, the power to be generated in the central power house. He proposed to substitute for the 10 steam winches an equal number of electric winches of 8 or 10 H.P., the current to be conveyed to these winches by means of flexible cables. He estimated that the additional cost of electric over steam winches would be about £1,000, but the advantages gained would outweigh this consideration. In the discussion some doubts were expressed as to the possibility of making motors sufficiently water-tight to stand the heavy seas washing over them on deck, and it was thought by some that it would be necessary to make the winches portable and run them into a dry store during a rough voyage. Replying to this point, one speaker referred to 12 motors, which, at the beginning of the Boer war, were abandoned in a mine, and after being submerged under 500 ft. of water for two years, were taken out and simply stove dried. Out of the 12, only two were found to be unsuitable for regular work again. Mr. Roberts, in reply, referred to the tramcar motors at Cardiff, which, it is said are submerged on any wet night, yet no trouble arises from this cause.

Royal Society.—Among the papers down for reading yesterday were the following:—

Prof. J. Dewar, F.R.S., on "Physical Constants at Low Temperatures. (1) The Densities of Solid Oxygen, Nitrogen, Hydrogen, &c."

Prof. W. A. Tilden, F.R.S., on "The Specific Heats of Metals, and the Relation of Specific Heat to Atomic Weight." Part III.

F. E. Smith, on "The Construction of some Mercury Standards of Resistance, with a Determination of the Temperature Coefficient of Resistance of Mercury." Communicated by Dr. R. T. Glazebrook, F.R.S.

Prof. A. Gray, F.R.S., and A. Wood, on "The Effect of a Magnetic Field on the Rate of Subsidence of Torsional Oscillations in Wires of Nickel and Iron, and the Changes produced by Drawing and Annealing."

Fatality.—Father Bouchard, a Jesuit priest and expert electrician, met a shocking death at St. Mary's College, Montreal, last month. He took a lantern and went beneath the stage in the library to find some irregularity in the wiring. His fate was not known until some members of the fire brigade, who had been summoned to extinguish a fire, found the body of the unfortunate priest in a prostrate position and perfectly rigid, with one hand clutching a wire and the other holding the lantern. Smoke caused by the contact filled the space. One of the firemen reached forward to release the body and was knocked off his feet by the current. It appears that the priest's lantern was against a second wire, and completed the circuit.

Tramways and Light Railways Association.—The annual dinner is to take place in the Picture Galleries, Prince's Restaurant, Piccadilly, on Wednesday, April 13th.

"Slaves of the Lamp."—Under this oriental title, Mr. F. D. Godwyn, in the *Strand Magazine* for March, describes the perils and dangers of the electrical engineer's profession—"a variety of deaths and maimings that can scarcely be surpassed." The author's tales appear to be founded on fact, and are sensational enough, one of them being "The Greatest Electric Shock on Record," which was published in our "Correspondence" columns some time ago. Unfortunately, the artist has not been equally successful in his attempts to portray the scenes described by Mr. Godwyn. The article as a whole is interesting, and happily it ends with an assurance that the ordinary householder need not fear that such lively accidents will take place in his own house.

Snowdonia Electric Railway Scheme.—The following letter, addressed to the editor of the *Times*, strikes a common-sense note with which we cordially sympathise; while we appreciate the attitude of those who are solicitous for the preservation of natural beauties, we deny that these should be preserved for the sole use of summer tourists, or that an electric tramway in any degree detracts from their attractions:—

"Sir,—You will, I anticipate, allow a very limited space to a Welshman from the district for the purpose of protesting against the efforts of Prof. Ker and his sympathisers to keep as a sort of 'preserve' for the 'non-producing' class of Englishmen—as Adam Smith would term them—our glorious hills and valleys. By a system of tramways through one or two narrow strips of our mountain scenery it is proposed to make accessible to all classes hundreds of beautiful spots which the eye of no jaded worker from our great towns has ever seen, for the good reason that neither time nor money permitted it. The suggestion that a narrow line of rails, with wire overhead, running through the district can in any way interfere with the scenery is too unreasonable to discuss. Prof. Ker may find room to tramp for three months through valleys from which every one, except wealthy tourists with whom time is no object, has been entirely excluded by their inaccessibility. The professor and the painter are welcome, but better far they should never come than that facilities should be denied to Birmingham and Lancashire tired producers, for whom Providence pre-eminently intended our mountain air.

"The word 'professor' has, however, further, an uncanny sound for us. It happens that a very large proportion of the men who desecrate mountain scenery by their lamentable climbing practices at the risk of self-immolation are 'professors.' This is peculiarly the case both in Wales and Switzerland, and we have an intense antipathy to the very names of our hills becoming things of horror like Sca Fell pinnacle and many others.

"It will be, however, a delight to see thousands of Sunday school children and tens of thousands of the brawny sons of old England feasting on what they have never seen before, and never would see but for such as enterprise as this. I will mention that I do not know any one of the 'promoters.'—A WELSH MAGISTRATE."

Rugby Engineering Society.—The last meeting of the Session was held last evening, when Mr. Hopp's paper on "Automobiles" was further discussed.

L.C.C. and Marylebone.—The question of advancing a loan to the Marylebone Borough Council for the purchase of a portion of the undertaking of the Metropolitan Electric Supply Co. was to have been considered at Tuesday's meeting of the London County Council. Lord Welby, chairman of the Finance Committee, stated, however, that he did not propose to move that part of the Committee's report which dealt with the question, as the Borough Council desired to make further observations in regard to the matter. It was, therefore, agreed to postpone the report for a week. In the course of the report, the Committee stated that they had arrived at the conclusion that they could not recommend the Council to make provision at the present time for raising and advancing the £1,365,000 required by the Borough Council. The amount asked for was exceptionally large, and the request came at a time when the conditions of the money market rendered it imperative that the Council's issue of stock should be kept within the smallest possible limit. The Committee proceeded to observe:—Although we do not see our way, for the reasons stated, to make provision in this year's Bill for the loan of £1,365,000 to Marylebone, we are so much impressed with the desirability, in the interests of London, of maintaining the principle of one central stock for all loans required, that we are prepared to advise the Council to entertain the proposal for the loan to Marylebone as soon as the financial situation becomes sufficiently favourable. In these circumstances, we are of opinion that the Borough Council should make some temporary arrangement for meeting this liability rather than attempt to create a permanent debt at a most disadvantageous time. The financial conditions which have led us to recommend the Council not to make provision this year for raising this large sum of money on behalf of Marylebone would operate as strongly, if not more strongly, against the issue of a local stock charged on the rates of that borough. We think, therefore, that the Borough Council should endeavour to arrange with the Metropolitan Electric Supply Co. for the payment of interest on the purchase money until the stock can be issued, or, if such an arrangement cannot be come to, should obtain powers from Parliament to borrow temporarily by means of Bills or otherwise the whole sum required, or so much of it as is necessary for payments which cannot be postponed, and that power should not be given for the creation of a local stock so long as this Council is willing to raise the money for Marylebone when the financial conditions warrant it. We recommend that the Council of the Metropolitan Borough of Marylebone be informed that the Council is unable to accede to the request that provision may be made in the Council's Money Bill of 1904 for

the lending by the Council to the Metropolitan Borough Council of the sum of £1,365,000, which that borough council may be empowered to borrow by the Marylebone Electric Lighting Bill, 1904, should that Bill become law; but that the Council will be prepared to entertain the proposal to lend the money as soon as the financial conditions are sufficiently favourable.

Shock Fatality.—On March 4th, a lad, aged 15, in the service of the London Electric Supply Corporation, received a 10,000-volt shock, while cleaning a terminal, which he ought not to have touched without orders. Evidence given at the inquest held at Southwark, on Tuesday, showed that when cleaning was necessary, the current was cut off, and there was no current where deceased was standing, but evidently he tripped, and put his hand on a "live" part. An electrical linesman named Baker saw the flash from the terminal in the corner of the room where the boy was, and he ran forward and caught him just as he was about to fall. He was unconscious. Baker at once sent for a doctor, and meanwhile started artificial respiration, with the result that the deceased regained consciousness. On recovering, he said, "Hullo! What have I done? What is it?" and then lapsed into a semi-conscious state again.

Dr. Kenneth Black, house surgeon at Guy's Hospital, stated that the lad, who was admitted to the hospital, was severely burned about the limbs. Part of the right arm was dead. He very soon got over the shock of the accident. Witness called in two surgeons, and it was decided to remove three limbs. On the Monday following deceased's right arm was removed, and on the Thursday both legs were amputated. The boy died eight days after admittance to the hospital from heart failure, following on the injuries he had received from the electric shock. It seemed to him incredible that a shock of 10,000 volts should have caused such comparatively slight injuries. The artificial respiration resorted to by Mr. Baker had undoubtedly prolonged deceased's life.

In returning a verdict of accidental death, the jury added a rider to the effect that a guard or guards, should, if practicable, in future be put over the terminals.

The Osmium Electric Lamp.—Some uncertainty appears to surround the circumstances under which an extraordinary general meeting of the Austrian Incandescent Gas Light and Electricity Co. has been convened, for the purpose of considering a resolution to authorise the separation of the incandescent gas light department from the osmium electric lamp department. It may be remembered that a similar scheme was brought forward about a year ago, and that if it had been carried into effect, the interests held in the Austrian company by the English Incandescent Gas Light Co. would have been beneficially affected. Unfortunately, however, the proposal could not be proceeded with owing to the abstention from the meeting of Dr. Auer von Welsbach, who controls over one-half of the company's share capital, and, in fact, the whole of that which represents the osmium electric lamp. Whether the new scheme will meet with his approval on the present occasion remains to be seen, but it does not appear that the manufacture of the osmium electric lamp, notwithstanding the establishment of a separate factory for its development, has yet emerged from the experimental stage in Austria. In Berlin, however, the construction and sale of the osmium lamp by the German Incandescent Gas Light Co. were commenced in October, 1902, and a few months ago the lamp was reported to be making progress.

Single-Phase Railway Traction.—News comes to hand that the Westinghouse Electric and Manufacturing Co., of Pittsburg, have received orders for the equipment of two long interurban railways in the States, on their single-phase system. The first order relates to the equipment of the Fort Wayne, Decatur and Springfield line, which extends from Fort Wayne, Ind., to Springfield, Ohio, a distance of about 110 miles. The second order comes from the Indianapolis and Cincinnati Traction Co., who are constructing a high-speed line between Indianapolis and Connersville, Ind., the whole length of which—53 miles—is to be worked electrically.

It is interesting to note that in the case of the latter line the controlling gear will be such that while over most of the line the cars will be operated with 3,300 volts alternating at the trolleys, inside the limits of the city of Indianapolis the ordinary 500-volt direct-current supply will be made use of. These two lines will be the first in the world to be equipped upon the single-phase system, and their completion and working will be looked forward to with interest by British railway engineers as inaugurating the new system to which we look for the future electrification of our steam lines.

Lectures.—On 11th inst., at the University, Birmingham, the Principal, Sir Oliver Lodge, delivered the concluding lecture of a series delivered to the medical practitioners of the city upon "Physics Applied to Medicine." Sir Oliver gave illustrations of the operation of high frequency oscillating currents, and the apparatus by means of which they might be applied to medical uses.

Personal.—On March 9th, at the Anglican Church, Cottesloe, Western Australia, Mr. E. L. Webb, A.M.I.E.E., of the electrical staff of J. Barre Johnston & Co., Murray Street, Perth, W. A., was married to Miss May Foster, younger daughter of W. Foster, Esq., of Higher Broughton, Manchester.

It is announced that on May 5th, a marriage will take place between Frank Hugh, youngest son of Sir William Preece, K.C.B., and Bertha Caroline, eldest daughter of the late Rev. W. A. Johnston, rector of Acrise, Kent, and of Mrs. Johnston, of Hazelwood, Wimbledon.

We hear that Mr. E. Stallibrass is resigning his appointment as general manager and engineer to the Amazon Telegraph Co., in Brazil.

The Ashton-under-Lyne T.C. has increased the salary of Mr. A. Coveney, tramway manager, from £150 to £200 a year.

Mr. James Lockwood, how has held the position of District Superintendent of the Manchester Branch of the Edison and Swan United Electric Light Co. for seven years, resigns that position from the end of the present month, having been with the company nearly ten years.

Appointments Vacant.—Shift engineer (£104) for Ilford; junior assistant for Accrington (£65).

Electricity in Mining. — The question of electricity in its application to mining was further discussed by the Manchester Geological and Mining Society at its meeting last week. Colonel Hollingworth was in the chair. Mr. Maurice Georgi, of Edinburgh, read a paper on "The Application of Electricity for Winding and other Colliery Purposes." He premised that electrical energy offers the mine owner and engineer all desirable guarantees, as far as convenience, economy and security are concerned. The best proof of this lies in the fact that nearly all the principal mines in Germany are being equipped electrically throughout, as far as their means allow it. For the newer mines anything besides electricity, as a motive power, is hardly considered. Mr. Georgi referred in detail to electrical machinery for pumping, ventilating, winding and haulage, and coal cutting; and said that although the initial outlay for an electrical plant might be from 20 to 25 per cent. more than if steam were used, the saving in working expenses afterwards would be as much as 50 per cent. As electricity could nowadays be transmitted with the utmost ease and very economically over practically any distance, he submitted that mine owners in a district would reap considerable advantage by uniting to erect a power station of large dimensions sufficient for all their wants. Energy could be generated at an exceptionally low cost; all boilers, piping, chimneys, steam engines as now found in almost all corners of a mine, would disappear; all the power needed being provided by electric motors, occupying much less space and needing no supervision. Energy would be at hand up to any amount, day and night, so that any extension of the power plant of a mine would be the easiest thing in the world. Apart from these advantages—only appreciated by those in possession of an electrical plant—the economy in fuel would be 50 per cent. at least, repairs would sink to a trifle, and three-fourths of the labour required to run the mine would be done away with.

Referring to the important subject of mine ventilation, Mr, Georgi said that, as a rule, mine ventilators were of two kinds, viz., small fans, used for ventilating certain parts of a mine, and large fans that have the main task to do. The first are used in places where the main draught has little or no access, or to clear the atmosphere after an explosion, &c. It is obvious that from this type of fan very substantial advantages can be reaped by using electricity as motive power; the space occupied is small, and the efficiency very high, especially when, as very often is the case, motor and fan have a common shaft; and further, the whole arrangement can be very easily transported. Electricity besides being the only economical form of energy for driving small fans, offers great advantages for the main ventilators used for aerating a pit from the surface. As a rule, in larger mines one shaft is used exclusively for this purpose, in the immediate vicinity of which is placed the ventilator, driven by a special steam engine, having sometimes its special boilers. This is an arrangement which needs two men, at least, to fire the boilers and attend to the steam engine (as the ventilator is kept going day and night): but, driven electrically, no attendance whatever is needed—the ventilator need only be visited once or twice during the day. The cost of the plant is greatly reduced, as the motor can run at a high speed, 400 to 500 r.p.m.

Some discussion took place upon the paper, in which the opinion was expressed by several members that if Mr. Georgi's conclusions were sound, and safety in the use of electricity could be guaranteed, there would be no lack of orders for electrical installations in the Manchester district.

Mr. Georgi said that his conclusions were based on actual experience.

Influence of a Magnetic Field on Photographic Processes.—A. Schweitzer has carried out a research to ascertain whether magnetism plays any part in the reactions when photographic plates or papers, sensitised with silver or iron salts, are treated in the usual manner. He finds that no appreciable alteration in the chemical constitution occurs in the halogen compounds of silver, or in those salts of iron that are sensitive to light when they are exposed to the influence of a magnetic field. Similarly no acceleration or retardation of the ordinary photo-chemical processes is to be noticed when they are conducted in the presence of such a field.

Bauxite in Italy.—Although bauxite has hitherto been unknown in Italy, minerals containing a noteworthy proportion of alumina have recently been discovered in that country. In the Rocca di Mezzo district an ore has been found containing 25 per cent. of ferric oxide, which was, therefore, too poor to be worth treating in the blast furnace; but, on examination, it proved to contain 56 per cent. of alumina. Materials have also been met with recently in other parts containing 58 and 57 per cent. of aluminium oxide, and, at Frascati, leucite, a potassium aluminium silicate, has been discovered, which has given, on analysis, 55 per cent. of silica, 23·5 per cent. of alumina, and 21·5 per cent. of potassium.

(*Continued on page* 469)

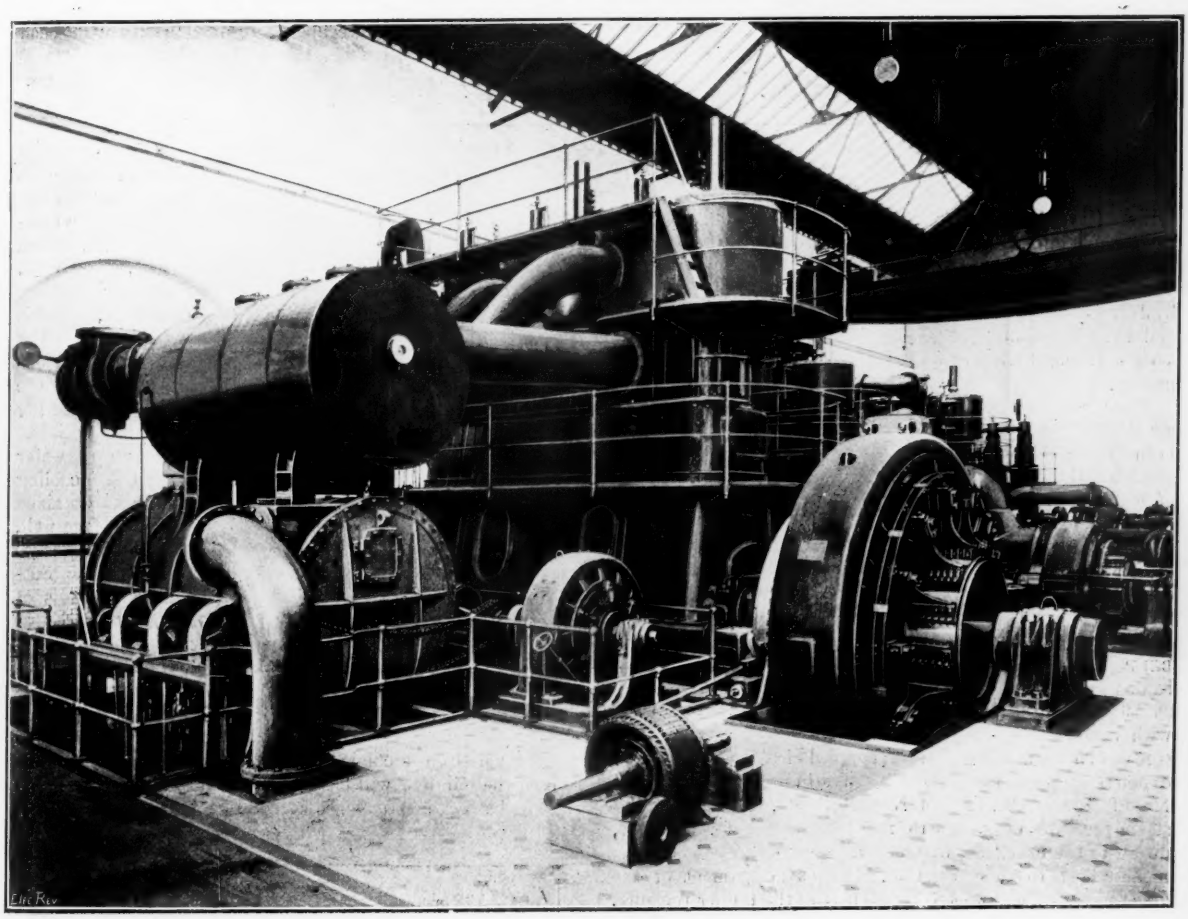
THE ELECTRICITY WORKS AND DESTRUCTOR OF THE METROPOLITAN BOROUGH OF HACKNEY.

(Concluded from page 426.)

All the generating sets originally installed consisted, as shown in the illustrations, of balancing dynamos coupled in tandem, two dynamos to each engine; the whole of this plant, consisting of eight dynamos and four engines, was supplied by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne.

The four smaller dynamos are rated at 150 KW. each, with an overload capacity of 165 KW.; they are coupled to changeable. A spare armature could be seen in the foreground of the general view published in our last issue, showing the shaft with a coupling on the commutator end.

As previously mentioned, advantage has been taken of this construction to couple a third machine to one of the smaller sets; this is a booster of 72-KW. output, supplied by the British Westinghouse Co., and is designed to give a current of 400 amperes at a pressure varying from 180 to



Belliss-Westinghouse 1,500-kw. Steam Dynamo and Condensing Plant.

Willans triple-expansion three-crank vertical single-acting high speed engines of 500 I.H.P. each, and run at 300 r.p.m. The four larger dynamos are rated at 300 KW. each at full load, with an overload capacity of 330 KW. for two hours, and are coupled to Belliss triple-expansion vertical three-crank double-acting high speed engines, of 1,000 I.H.P. each, running at 300 r.p.m. These engines are provided with forced lubrication, and work with a normal steam pressure of 175 lbs. per sq. in.

All the dynamos are shunt-wound, generating at 240—275 volts, and are of the Johnson-Lundell patent type, having the special form of divided magnet core and extended pole tip peculiar to this type of generator. The armatures are on separate shafts provided with a coupling at each end, so that the armatures of each set of four similar machines are inter-

20 volts. Although this machine is a recent addition, and was therefore not provided for in the specification for the Willans engine, the latter has proved capable of driving the three generators apparently without feeling the difference, the steam consumption per KW.-hour being practically unaltered by the extra load.

The engines are all intended to work with steam superheated to 500° F., and each pair of similar engines exhausts into a common condenser placed between the two. The steam consumptions ascertained by full-load trials are, for the 300-KW. sets, 22·23 lbs., and for the 600-KW. sets, 19·94 lbs., of steam per KW.-hour. The average working consumption has been found to be 27 lbs. of steam per unit measured at the switchboard, and 4 lbs. of rough small coal per unit when the destructor is not in use.

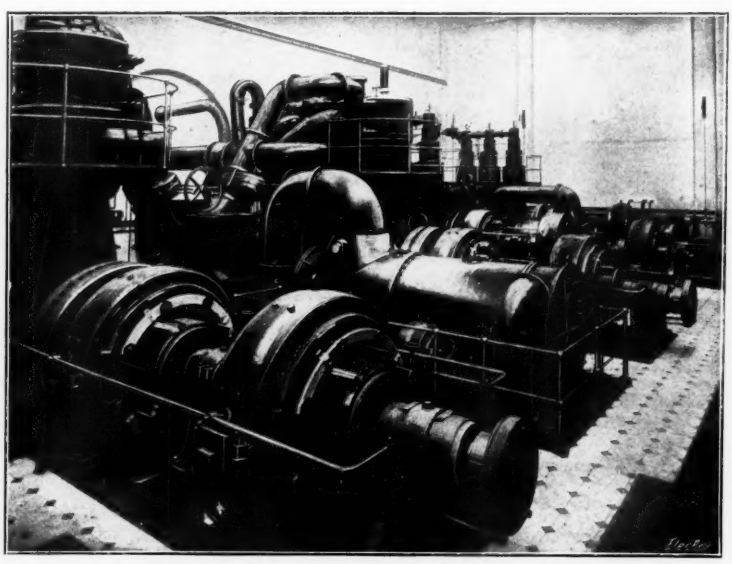
F

The two Willans engines are provided with a common exhaust to atmosphere, while the Belliss engines have each a separate exhaust, which is led out through the roof.

Klein Cooling Tower.

The condensing plant in each instance was supplied by Messrs. Cole, Marchent & Morley, of Bradford, and consists of a surface condenser fixed above a large oil separator in the basement, through which the exhaust steam is first led. The air pumps are of the Edwards type, and like the circulating pumps, are separately driven by Johnson-Lundell and British Thomson-Houston motors.

The remaining generating set has been recently installed, and consists of a Belliss engine of the same type as those above mentioned, capable of giving 2,150 B.H.P. at normal load, and 2,650 B.H.P. at maximum load, when running at 165 r.p.m., and with a steam pressure of 175 lbs. at the stop valve, coupled direct to a 1,500-KW. dynamo supplied by the British Westinghouse Electric and Manufacturing Co., Ltd., of Norfolk Street, London. As the steam pressure varies up to 225 lbs. per sq. in. at times, owing to the use of the destructor, the engine has to accommodate itself to this variation, without adjustment of the governors, and will work continuously at the higher pressure.



General View of Generating Plant.

The generator is a 10-pole machine of the latest pattern, and has a normal full load capacity of 1,500 KW., at 490 to 560 volts, this machine, unlike the others, being connected between the outers of the three-wire system. The combined weight of the engine and dynamo, including the fly-wheel, is 121 tons, and the over-all height is 19 ft.; the diameter of the crankshaft is $9\frac{3}{4}$ in., while that of the generator is from 18 to 22 in. The addition of this very fine generating set, which occupies a floor space of 32 ft. 6 in. × 15 ft. 8 in., has practically doubled the output of the station. We give on p. 465 an illustration showing the set complete with the condensing plant associated with it.

The latter was supplied and erected by Messrs. Ashton, Frost & Co., and consists of a large oil separator and a surface condenser, with air and circulating pumps. The oil separator is, in this case, uppermost, and consists of a cylindrical shell fitted with baffle-plates. The condenser has a cooling surface of about 4,500 sq. ft., and occupies a floor space of some 15 ft. × 6 ft. 6 in. The three-throw air-pump is of Edwards type, with barrels 15 in. in diameter, stroke 8 in.; it is driven direct by a six-pole Westinghouse motor of 56 H.P. at 160 r.p.m. The three-throw double-acting circulating pump has a capacity of 2,000 gals. per minute, with barrels 13 in. in diameter and a stroke of 10 in.; it is driven from the same motor as the air-pump by two Renolds roller chains, at a speed of 87 r.p.m. The complete plant is capable of dealing with a maximum of 40,000 lbs. of steam per hour; up to 30,000 lbs. per hour a vacuum of 27 in. is expected, with circulating water at 70° F.

The method of driving the pumps above described should give excellent results; the load on the air-pumps being a maximum at starting, and that on the circulating pumps a minimum, and these conditions being reversed when full speed is attained, the combined torque required from the motor remains approximately constant throughout.

The engine is provided with an atmospheric exhaust, and in this case an automatic valve is fitted, in addition to an ordinary valve.

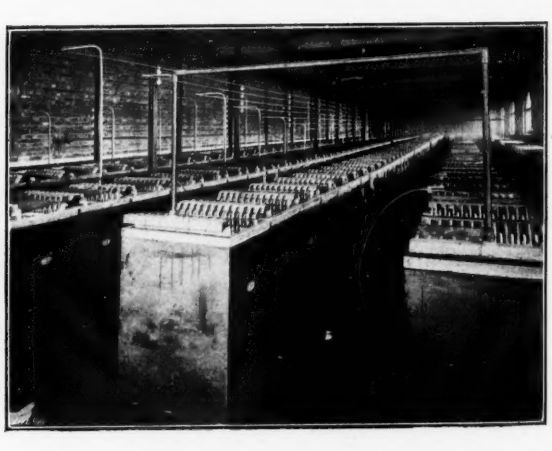
A small pump, driven by an eccentric on the end of the shaft of the circulating pump, sends the oil from the separator to a settling tank, whence oil can be drawn off for rough purposes, the water being drained away by a cock Used lubricating oil from the engine crank chambers is taken to a settling tank and afterwards pumped into filters.

At present cooling water for the condensing plant is obtained from a reservoir surmounted by a cooling tower, of which we give a view. The tower is of the open type, capable of dealing with 3,000 H.P., and was supplied by the Klein Engineering Co.

Make-up water for the cooling pond is obtained from a surface well, sunk by Messrs. Le Grande & Sutcliffe, by means of a 3-in. centrifugal pump.

The space remaining unoccupied in the engine room is sufficient to accommodate a second 1,500-KW. generating set, after which the building will have to be extended.

The battery is situated over the switch room, stores, &c.,



Tudor Battery.

adjoining the engine room, and consists of 304 Tudor cells, type L C 23; it is capable of giving 600 amperes for four hours, or 1,450 amperes for one hour, at 550 volts. The plates

are 14 in. wide × 24 in. high, the depth being specially great in order to economise floor space; nevertheless, this large battery, of which all the cells are in one tier, fully occupies a room as long as the engine room, as shown in our illustration. The purpose of installing so large a battery was to utilise to the utmost the energy derived from the destructor, and it is interesting to note that this object has been satisfactorily attained.

The arrangement of the cells—all in one tier, as mentioned—is the only one which should ever be tolerated. In this case, they are also housed in a well-ventilated room, with space enough to work between the rows, on both sides, and a supply of water is laid on at one end of the room. A tank containing distilled water (derived from the steam range) is fixed at the other end, to provide make-up for the cells. Some difficulty was met with at first in maintaining the density of the electrolyte uniform, on account of the unusual depth of the plates; this was overcome by introducing the make-up water through one of the separating tubes, thus guiding it to the bottom of the cell.

The electrolyte is contained in lead-lined wooden boxes, carried on insulators, these again being supported by wooden baulks mounted on porcelain insulators.

The conductors for the regulating cells—which are next the middle wire—consist of copper rods carried on insulators; they are taken off every alternate cell, from No. 96 to No. 152 in each half battery, and are of $1\frac{1}{8}$ and $\frac{3}{4}$ in. diameter, the smaller rods beginning at No. 126. A milking booster is provided to take care of sick cells.

The battery is charged from the destructor at night, and floats on the lines in the daytime as a standby; it is discharged in the evening during the peak-load, a *complete* discharge being taken from it every day. A full record of the behaviour of each cell is kept on the card system, which has proved of great value. In passing, we may add that the same system is applied to the whole station, every engine, boiler, &c., having a separate card record.

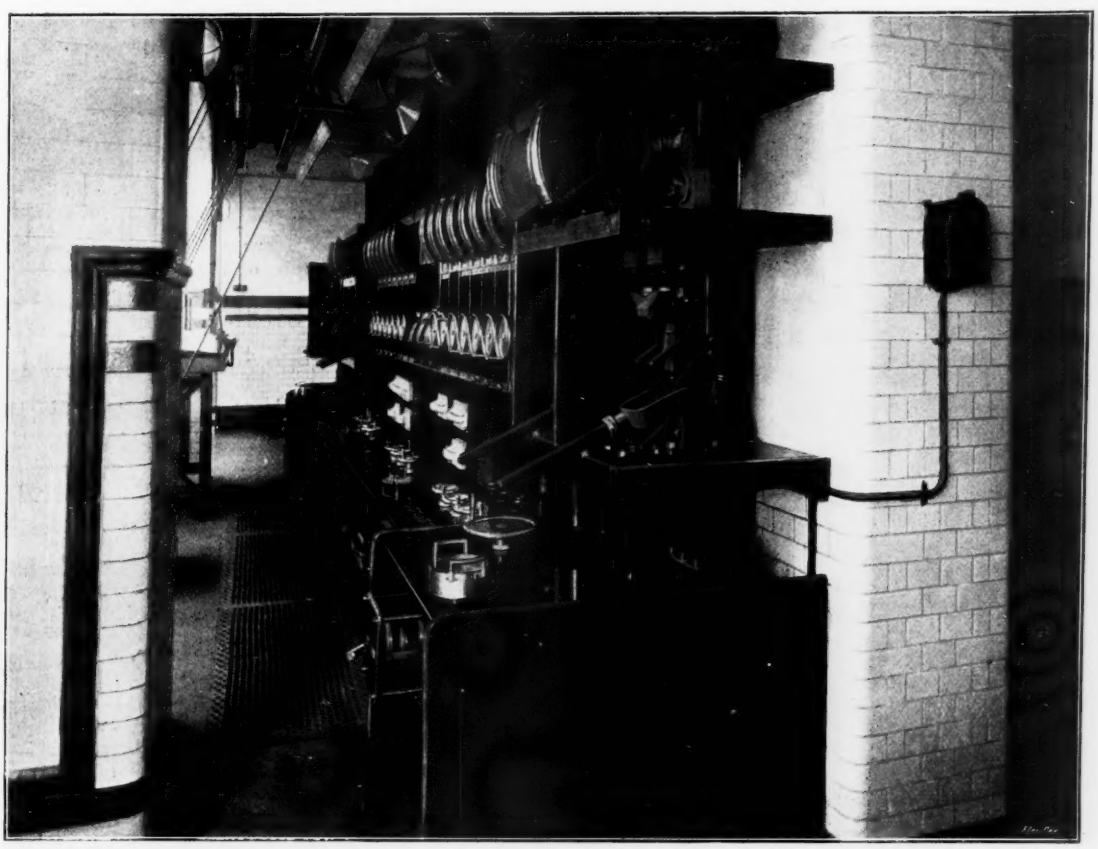
The input and output of the two halves of the battery are also separately metered, in ampere-hours.

We now turn to the switchgear, which possesses several features of interest. This is housed in a recess opening upon one side of the engine room, the wall of the latter being supported on massive brick columns. The switchgear is divided into two sections by a substantial brick wall, against which the generator panels are built on one side and the feeder panels on the other, back to back. Our view shows the former, and will give some idea of the arrangement; the feeder gear, however, being situated in the passage on the right cannot be seen. All the switchgear was supplied by Messrs. Ferranti, Ltd., and is of their standard direct current type.

On the centre of the board are two recording Elliott voltmeters, and three edgewise ammeters—one for the neutral (250—0—250), one for the earth wire (500—0—500), and one for the motor booster (0—400); a throw-over switch to short circuit the earth wire ammeter, and the regulating and main switchgear of the booster are fixed below, while the pilot wire fuses and terminals, and the voltmeter switches, are fixed on the front of the bench.

The board is of the divided polarity type, the positive and negative sides being alike. At the top of each half are two edgewise voltmeters, and a set of four horizontal bus-bars running the whole length of the board. Crossing these are vertical bars corresponding with the switch panels, which can be coupled to any one of the horizontal bars by means of expanding plugs. Below the bars are edgewise Evershed & Vignoles ammeters. There are nine panels in each half, allotted respectively to the works motor circuit, the artificial load, battery, and generators 1 to 6. The first seven switches are of the screw type, and of these the first three are fitted with oil-break fuses; the remainder are provided with reverse current cut-outs, which trip the main switches, there being no fuses or maximum circuit-breakers on any of the generators. It will be noted that this arrangement is precisely what has been strongly advocated since the Bristol accident; but it was adopted at Hackney years before the Bristol fire took place.

Regulating and main switches for the field circuits are fixed on the bench, with paralleling sockets to fit the pins of the portable voltmeters, one of which is shown in position in



Ferranti Main Switchboard.

the foreground of our view. There are no ammeters in the field circuits.

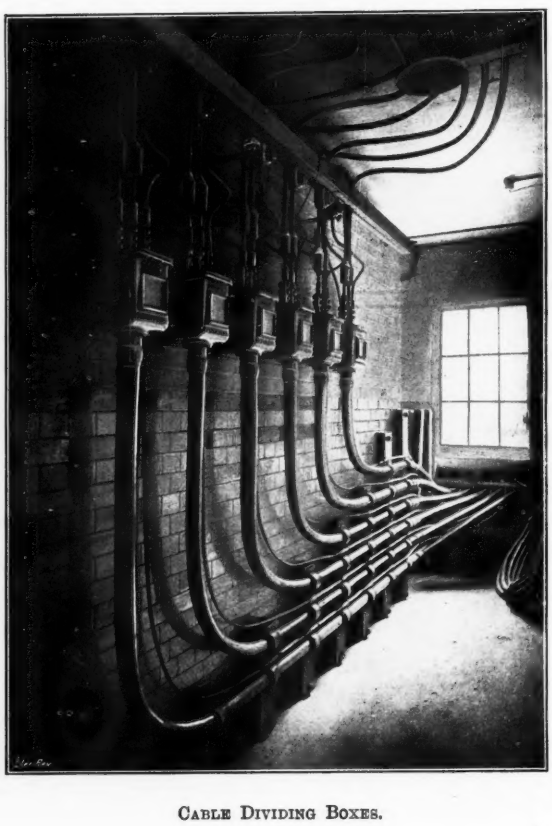
The last two are extension panels for 1,500 KW. each, and are of a much heavier type; one of these is spare. The slate slabs forming the end partition are removed in our view, to show the parts of the switchgear.

The bus-bars are extended to these panels by means of heavy disconnecting links. Each panel is provided with a Nalder ammeter reading to 4,500 amperes, and the field controlling gear is fixed below.

These heavy switches are provided with relay reverse current cut-outs, which trip both positive and negative main switches simultaneously, the dynamo being in this case coupled to the outers of the three-wire system. The polarised relay for one pair of switches is shown fixed on the end of the dividing wall; the other relay is fixed in the corresponding position at the other end.

The switches are provided with auxiliary breaking contacts in the panels, as well as with magnetic blow-outs on the top of the board to take the final break.

The battery switchgear is arranged along the roof of the switch gallery; the contacts are moved by two leading



Cable Dividing Boxes.

screws, for charge and discharge respectively, and the positions of the contacts are shown by means of pointers on numbered scales. The contacts are of the usual resistance type. The screws are actuated by sprocket wheels and chains, the hand-wheels being mounted on a pedestal in front of the switchboard platform. As the battery room is overhead, the connections from the cells are brought straight down through the roof to the corresponding contacts without complication or difficulty in fixing.

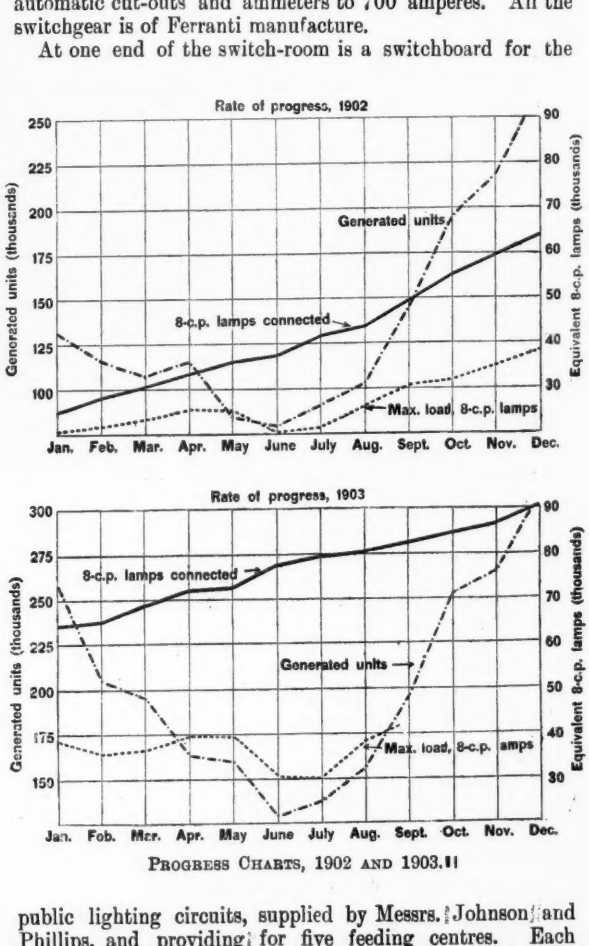
It was originally intended to run two or more station pressures, but this was found inconvenient and not economical; the present mode of working is as follows:—The battery, works motor and exciting circuits are always plugged on the bottom bus-bar, called the "home bar." The generators and feeders are plugged on to another bar, called the "load bar," and these bars are plugged together through one set of plugs only. In the case of a shut-down —which, happily, has not yet occurred—the plug connecting the home bar with the load bar would be removed, leaving the works supplied with power and light from the battery, so that any work necessary for the resumption of supply could be carried on without difficulty. The generators would then be switched on to the load bar, excited from the battery and run up on the load gradually. The feeder switches would not need touching at all.

The feeder switchgear consists of positive and negative

Map of Area Supplied, Showing Routes of Mains, Street Lamps, and Position of Electricity Works.

panels for 13 feeders, fitted with fuses and ammeters reading to 500; and for four feeders, fitted with maximum automatic cut-outs and ammeters to 700 amperes. All the switchgear is of Ferranti manufacture.

At one end of the switch-room is a switchboard for the


Rate of progress, 1902
Generated units (thousands)
Equivalent 8-c.p. lamps (thousands)
Generated units
8-c.p. lamps connected
Max. load, 8-c.p. lamps
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
Rate of progress, 1903
8-c.p. lamps connected
Generated units
Max. load, 8-c.p. amps

Progress Charts, 1902 and 1903.

public lighting circuits, supplied by Messrs. Johnson and Phillips, and providing for five feeding centres. Each circuit is fitted with an ammeter, double-pole switch, and fuses. There are also two large rheostats, one for the positive circuits and the other for the negative; these are

used for switching on the arcs and bringing them all up together, without an excessive rush of current.

A new works power board has recently been erected to supply all the large motors, comprising 12 three-wire 200-ampere circuits, and a new booster switchboard, fitted with circuit-breakers, throw-over switches and ammeters for the two boosters; both these boards were supplied by Messrs. Ferranti, Ltd., and are of handsome and massive construction.

Beneath the switchboard is ample space for the cables to generators and the feeders, the regulating rheostats, &c. An Aron watt-hour meter is in circuit with each generator, and an Aron ampere-hour meter in circuit with each half of the battery; the latter meters are provided with two sets of dials and a change-over mechanism, so that the charge and discharge are separately registered. A watt-hour meter, standardised in place, is permanently fixed under the switch room in conjunction with an artificial load, by means of which any generating set can be tested on load without special preparation. This is a valuable aid to the maintenance of the maximum economy, as the performance of any machine can be checked with facility after repairs, &c., and the effect of alterations in the system of working can be precisely ascertained. Thermometers are provided to indicate the temperatures of the superheated and exhaust steam, the discharges from the air pumps and the condenser tubes, &c., and in effect a continuous test of the working of the station is maintained, with a view to securing the best possible results.

The feeders and distributors are all triple-concentric, paper-insulated and lead-covered, and were supplied and laid by the British Insulated Wire Co., Ltd., Prescot; they were laid on the solid system, in earthenware troughs 2 ft. 6 in. deep under the footways, and in iron troughs 3 ft. deep under roadways. The feeders are received in the station on a very convenient system, the dividing boxes being bolted on either side of a vertical wall (as illustrated herewith), and bearing cards inscribed with the position, size, and length of the cable, the resistance of each core, and other particulars of value to the cable staff. This arrangement was designed by Mr. J. Bowden. The feeders first laid were all of 0·4, 0·5, 0·6 or 0·7 sq. in. cross-section; all the later cables will be of 0·75 and 1 sq. in.

The works lighting system, which was installed by Messrs. Marryatt & Place, is fed from a point in the network, but in emergency can be switched over to permanent connections on the batteries, clear of all the switchgear.

The meters used on consumers' premises are of the Chamberlain & Hookham, Ferranti and Reason (electrolytic) types. The rapid progress of the private consumers' connections may be gathered from the diagrams given herewith; the latest figures available (to December 31st last) show that they then amounted to the equivalent of 90,881 8-c.p. lamps.

The public lighting system comprises 303 10-ampere and 40 7-ampere arc lamps, 40 ½-ampere Nernst lamps, and in the adjoining borough of Stoke Newington, nine 10-ampere arc lamps. The last-mentioned, our readers may remember, were installed on the Stoke Newington side of High Street to balance the brilliant illumination of the Hackney side.

The working of the destructor in conjunction with the electricity works has given satisfactory results, though we think the electricity department pays somewhat dearly for the energy so obtained—namely, on the basis of 5 lbs. of coal per unit generated. That is to say, the total number of units generated are multiplied by five; the number of lbs. of coal used are deducted from the product, and the remainder are paid for at the price of coal, including handling. While these terms benefit the Health Department, they press rather hardly on the Electricity Department, which can generate energy for less than 4 lbs. of coal per unit, inclusive of all losses. As shown in the statement of accounts for the year ended March 31st, 1903, even then the returns constituted a record for the metropolis, the works cost amounting to only 0·79d., while the total costs, exclusive of capital charges and carbons, trimming, and maintenance of public lamps, were 1·03d. The prices charged are—4d. per unit for lighting, with a discount of 10 per cent. to certain long-period consumers, and, for power, 2d. for the first 1,000 units per quarter and 1½d. per unit for all consumption in excess of this quantity. These prices are attracting large power users.

In conclusion, we have to thank the borough electrical engineer, Mr. L. L. Robinson; the consulting engineer, Mr. Robert Hammond; and some of the contractors for their kind assistance in the preparation of this article. Mr. Robinson is assisted by Messrs. J. R. J. Bowden and T. Dalby, the former as chief assistant, the latter as works superintendent.

NOTES.

(*Continued from page* 464.)

South African Notes.—*Cape Posts and Telegraphs.*—From *South Africa* we learn that the revenue earned by the Cape Colonial Telegraph Department last year totalled £237,836, a decrease of £78,763 upon the receipts of 1902. The shortfall is more than accounted for by the diminution in the amount of revenue derived from the transmission of Government and Imperial messages, payments for the former dropping from £47,992 in 1902 to £29,441 in 1903, and for the latter from £86,399 to £3,829. On the other hand, the department received last year £152,186 for transmission of public messages, an increase of £9,409 over the amount for the previous year, while payments from other administrations were £12,363, being £7,609 in excess of that for 1902. Private wire rentals also showed an increase on last year, the receipts under this heading being £36,397, as against £28,291 for 1902. Altogether 3,946,619 messages were sent over the Colonial telegraphs in 1903, a decrease of £492,840 upon the number dealt with during the previous 12 months. The sum of £770,195 was earned by the department of Posts and Telegraphs last year, being a decrease of £52,637 upon the receipts of 1902. The only falling off was on account of telegraph revenue.

Durban Tramways.—Messrs. Dick, Kerr & Co. have practically completed six electric tramcars for the Durban Municipality, and these will be shipped to Natal in a few weeks' time. The cars are of the same pattern as those already in use in Durban.

The Transvaal Electrical Imports.—The value of the electric cables, wires and fittings imported into the Transvaal during the 11 months ending with November last amounted to £60,000, as compared with only £41,000 in the corresponding 11 months of 1902.

East London.—The Allgemeine Elektricitäts Gesellschaft, of Berlin, have secured the contract for supplying the East London Harbour Board with electrical plant for power and lighting.

An Electrician's Suicide.—An inquest was lately held at Beaconsfield, near Kimberley, South Africa, on the body of George Robinson, an electrician employed at the Premier Mine, who had died suddenly. It transpired that the deceased had told some companions the night before his death that they would not see him again. A quantity of prussic acid was found in the stomach, and a verdict of suicide was returned.

Electric Telpherage.—It will be seen from our advertisement pages to-day that the Natal Government is inviting tenders for the equipment of the ground and first floors of the Railway Customs Bonded Warehouse, Port Natal, with a complete system of electric telpherage.

Lourenço Marques Tramways.—On February 15th, at the invitation of the Delagoa Corporation, about 150 guests assembled at the tramways power station in connection with the opening of the electric tramways. Various toasts were honoured, and, after an inspection of the machinery, the company went for a round trip on the seven-mile route. The public were allowed free rides in the evening, and the regular service was started on February 16th.

Electric Regulations in Australia.—At the end of January last, a conference of electrical engineers was held in Melbourne, on the invitation of the Postmaster-General, to consider the draft regulations which had been framed under the Post and Telegraph Act of 1901. Sub-committees were formed to deal respectively with tramways and electricity supply, and reported to the conference, which then recommended the excision of a number of regulations which it considered to be beyond the powers conferred on the Minister by the Act, the latter being intended to protect the telegraph lines and works from interference. The regulations appear to have been framed in a tyrannical spirit; for example, the Government stipulated that A.C. transmissions should be carried on by means of underground cables, and that if a leakage on an electricity supply system should interfere with a telegraph circuit, the supply should be at once cut off. A committee was appointed to meet the Postmaster-General and his board of experts, to explain the attitude of the conference.

Obituary.—We learn with regret of the death, at the age of 71 years, of Mr. Charles John Galloway, who for many years was an active member of Galloway, Ltd., boiler makers and engineers, of Manchester. Death occurred suddenly at Knutsford on Monday.

The death is announced of Mr. Peter Mosley, of Gateshead, who, when a lad, was employed by the Electric and International Telegraph Co. The *Westminster Gazette* describes him as the "father" of the telegraph service.

THE CENTRAL STATION ENGINEER.

Mr. F. Thursfield, who has been electrical engineer to the Chester Corporation since 1896, has tendered his resignation of that position to take an appointment with Messrs. Preece and Cardew, London. Recently, a resolution to raise Mr. Thursfield's salary, from £495, by degrees to £700, was carried by the casting vote of the Mayor. At a subsequent meeting of the Council this decision was not confirmed. The Lighting Committee thereupon offered, as a compromise, to advance Mr. Thursfield's salary to £550. This he refused to accept. His acceptance of the new position and resignation of the old one are the outcome of that situation.

Mr. Thomas R. Stancombe, senior assistant engineer at the Wimbledon Municipal Electricity Works, has been appointed chief assistant electrical engineer to the Barnsley Corporation.

Mr. Jas. K. Bock, electrical engineer to the West Ham municipal undertaking, has resigned, to take an appointment at Buenos Ayres for Messrs. Livesay, Son & Henderson, civil engineers. The resignation was accepted with regret, and with many compliments to the retiring engineer. Mr. Bock, in expressing his acknowledgments, denied rumours that his resignation was caused through differences between the chairman of the committee and himself.

The borough electrical engineer of Walsall has been voted 150 guineas by the Council for extra work performed by him in connection with the construction and equipment of the tramways.

Mr. C. E. Davies, deputy tramway engineer at Cardiff, has been appointed resident engineer to the Wakefield and District Light Railway Co.

On Wednesday, at the St. Helens Depôt of the Swansea Tramways Co., a presentation was made to Mr. E. S. Rayner, resident engineer, who has resigned his position in order to take up the appointment of borough electrical engineer and tramway manager at Doncaster. Mr. David James, the general manager, presided. He congratulated Mr. Rayner on the very successful way he had managed the working of the station, and also expressed regret at his departure. The presentation was a case of Thornton's mechanical instruments. Mr. A. Johnston, chief assistant, takes up the position vacated by Mr. Rayner.

Mr. G. Holding, of Accrington, has been appointed shift engineer to the Newcastle-under-Lyme Corporation.

Last week the staff of the Cork Electric Tramways and Lighting Co. presented Mr. Charles Mittelhausen, the manager of the system, with a tantalus and some books at a farewell concert given in his honour. Mr. Mittelhausen has been appointed engineer and manager to the Bexley U.D.C. electricity department. The motormen, conductors and workmen, presented him with a gold watch. A torchlight procession escorted Mr. Mittelhausen to his residence at 3 a.m.

NEW COMPANIES REGISTERED.

Everyday Electricity Publishing Co., Ltd. (80,237).—This company was registered on March 4th, with a capital of £600 in £1 shares, to adopt an agreement with R. J. Nicholson, and to carry on the business of proprietors and publishers of newspapers, journals, magazines, books, and other literary works, printers, stationers, &c. The first subscribers are:—R. J Nicholson, 26, Cannon Street, Manchester, engineer, 25 shares; F. C. Taylor, 4, Delawney's Road, Crumpsall, Manchester, engineer, 25 shares; V. G. Mellin, 26, Blucher Street, Waterloo, Liverpool, railway superintendent, 1 share; Mrs. E. G. Granger, York House, Bordyke, Tonbridge, Kent, 1 share; T. C. Granger, York House, Bordyke, Tonbridge, Kent, lieutenant, 25 shares; A. Lockwood, The Berries, Cheadle, Ches., lime merchant, 1 share; and W. T. Hill, Greenhill, 82, Rathen Road, Withington, Lancashire, solicitor, 1 share. No initial public issue. The number of directors is not to be less than two nor more than five; the first are T. C. Granger, R. J. Nicholson (managing director), and F. C. Taylor; qualification, 25 shares. Registered office, 26, Cannon Street, Manchester.

Otto Electrical Manufacturing Co., Ltd. (80,263).—This company was registered on March 7th, with a capital of £10,000 in £1 shares, to acquire the English and foreign patents and applications thereof in connection with the manufacture of electric arc lamps, granted or to be granted to O. Gross, and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers (each with one share) are:—O. Gross, 14, Albert Place, Longsight, Manchester, electrical engineer; W. H. Wilson, 3, Newton Avenue, Longsight, Manchester, electrical engineer; L. B. Wilson, 3, Newton Avenue, Longsight, Manchester, electrical engineer; H. J. C. Somerville, 109, Victoria Street, S.W., engineer; A. W. Mason, The Park, Buxton, financier; W. F. S. Heath, 48, Swan Street, Manchester, solicitor; and G. M. Povey, 169, Upper Brook Street, Manchester, clerk. No initial public issue. The first directors are H. J. C. Somerville, J. Deakin, O. Gross and W. H. Wilson; remuneration, £100 per annum for governing director, and £50 each for the others.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electro-Voelker Syndicate, Ltd., Croydon (73,551).—A debenture, dated March 4th, 1904, to secure £215 15s. 9d., charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. No trustees.

Europe and Azores Telegraph Co., Ltd. (39,452).—This company's annual return was filed on February 12th, when 18,146 shares had been taken up out of a nominal capital of £200,000 in 20,000 shares of £10 each. £10 per share has been called up on 12,578, and £125,780 has been received. £55,680 is considered as paid on 5,568 shares. No mortgages or charges.

Municipal Electric Light and Power Corporation, Ltd. (29,091).—This company's annual return was filed on January 9th, when 37 ordinary and 80 founders' shares had been taken up out of a nominal capital of £25,000 in 2,490 ordinary shares of £10 each, and 100 founders' shares of £1 each. The full amount has been called up on each share, resulting in the receipt of £400. No mortgages or charges.

ELECTRICITY SUPPLY ACCOUNTS.

St. Helens Municipal Electrical Supply.

We give herewith an analysis of the year's results of the St. Helens Electricity Department. A considerable increase has occurred in the total output, although the public lighting supply shows a decrease. The figure for works costs (1·12d. per unit) includes an item of £1,045 for tramways maintenance on account of the Corporation lines leased to the New St. Helens and District Tramways Co., the revenue benefiting by £2,497 rent received from the company; deducting the item for tramways maintenance, for comparative purposes, it will be seen that the works costs at ·95d. per unit are among the lowest in the country.

Owing to the large proportion of tramway units, the revenue does not show a very great increase, and after meeting financial charges a balance remains on the year's working of £577.

The prices charged are—For private lighting, 4½d.; motors, 2d. and 1d.; and for traction, 1½d. per B.T.U. No meter rents. The borough electrical engineer is Mr. E. M. Hollingsworth.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£132,658	£123,150
Number of units sold—		
Private supply	448,823	355,095
Public lighting	51,704	55,033
Traction	1,014,218	827,837
Total number of units sold	1,514,745	1,237,965
Equivalent No. of 8-c.p. lamps connected	39,045	30,209
H.P. of motors connected	552	340
Number of public lamps	35	35
Maximum load in kw.	874	792
Revenue account—		
Gross revenue	£15,407	£13,162
„ expenditure	£7,070	£6,286
„ profit	£8,337	£6,876
Average price obtained per unit—		
Private lighting and traction	2·03d.	2·12d.
Public lighting	1d.	1d.

Revenue Account for Year Ending March 31st, 1903.

Gross revenue	£15,407 = 2·44d.	per unit.
Works and distribution costs ...	£5,138 = ·81d.	„
Total works costs	£7,070 = 1·12d.	„

Profit Statement.

Interest on loans, &c.	£3,959
Sinking fund	3,743
Sundry...	58
Balance on year's working	577
Gross profit	£8,337

Barrow-in-Furness Municipal Electrical Supply.

The returns of the Barrow-in-Furness Electrical Department give evidence that it is "turning the corner," and getting over the difficulties associated with its early days. With a largely increased output, improvements in works costs and revenue were obtained, and a credit balance of £425 remains on the year's working, as compared with a deficit in the previous year of £341.

The prices charged are—For private lighting, 6d. and 1½d., and for power, 3d. and 1½d. per B.T.U. on the maximum demand system. Mr. H. R. Burnett is the borough electrical engineer.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£67,373	£54,847
Number of units sold—		
Private supply	372,059	267,711
Public lighting	31,337	16,998
Total number of units sold	403,396	284,709
Equivalent No. of 8-c.p. lamps connected	35,856	22,958
Number of public lamps	48 arc 57 inc.	22
Maximum load in kw.	441	275
Revenue account—		
Gross revenue	£7,467	£5,281
„ expenditure	£3,881	£3,287
„ profit	£3,586	£1,994
Average price obtained per unit—		
Private lighting	4·3d.	4·3d.
Public lighting	4·1d.	4·55d.

Revenue Account for Year ending March 31st, 1903.

Gross revenue	£7,467 = 4·44d.	per unit.
Works and distribution costs (inc. pub. ltg.)	£3,022 = 1·80d.	"
Total works costs	£3,881 = 2·31d.	"

Profit Statement.

Interest on loans	£1,697
Sinking fund	1,464
Balance on year's working	425
Gross profit	£3,586

CITY NOTES.

City of Birmingham Tramways Co.

The report of this company for 1903, submitted on the 17th inst., states that revenue account, after providing for the year's interest on debentures (£12,000), and dividend on preference shares paid and accrued up to December 31st last (£12,083), shows a surplus of £59,978, from which is deducted £2,104, being interim dividend at 5 per cent. per annum on the ordinary shares for the half year ended 30th June, 1903, leaving a disposable balance of £57,873. The directors recommend a further dividend on the ordinary shares at the rate of 5 per cent. per annum, for the six months ended December 31st last, together with a bonus of 5 per cent. (making 10 per cent. for the year); that the balance of £51,559 be carried to reserve (increasing that fund to £242,744), to provide for depreciation of assets, redemption of debentures, and for general purposes. During the year there were carried 49,969,345 passengers, an increase of 2,008,476 passengers. Gross earnings amounted to £264,556, an increase of £9,865, and net earnings to £81,978, an increase of £30,197. Debenture redemption fund has been increased to £43,086. Sir Charles Rivers Wilson, G.C.M.G., C.B., has been appointed a trustee for the debenture holders in place of Mr. James Ross, resigned. The negotiations with the Corporation of Birmingham for a new lease of the tramways within the city came to an end in May of last year, when the Corporation passed a resolution in favour of the municipalisation of the tramways within the city. Running powers for the steam cars from Saltley and Perry Bar to Old Square have been granted by the Corporation of Birmingham to the company until January 1st, 1907, but permission to run the steam cars from Gravelly Hill to Old Square, pending the electrification of the Aston Tramways, has been refused, the Corporation having opened their electric tramways from Steelhouse Lane to the boundary at Aston Brook (1 mile). At the end of 1906 the leases of the following lines within the city will expire—namely, Small Heath (3 miles), Sparkhill and College Road (1⅜ miles), Moseley (1¼ miles), Kings Heath (1⅜ miles), Perry Bar (⅞ mile), Saltley (1⅛ miles), and Nechells (2⅛ miles). Except in the case of the two latter lines (which are entirely within the city), the services will be interrupted at the city boundary unless arrangements are made with the company, inasmuch as the company owns or has leases of the tramways on these routes beyond the boundary—in the case of Aston, for 21 years; in the case of Yardley, for 30 years, and only in the case of Kings Heath has the local authority outside the city boundary the right to purchase the tramway at a date corresponding with the expiration of the lease of the lines inside the city. The leases of the Bristol Road Electric Tramway and of the cable tramway to Handsworth do not expire till June 30th, 1911. The Bill promoted last session for securing a continuity of service over the lines inside the city from the suburban districts, was rejected. The Bill, however, authorises the company to construct additional tramways between the terminus of their College Road route and Shirley, a distance of about three miles, and from Sparkhill through Acock's Green to Olton, a distance of about 3¼ miles. The Act provides that these tramways are purchasable by the local authorities at the expiration of a period of 35 years from the passing of the Act, on the terms of paying the fair market value thereof as a going concern. The company has entered into an agreement with the Corporation of Aston Manor which provides for the immediate purchase of this company's tramways in the Aston district, and for a lease thereof, together with the Aston Council's tramways (formerly worked by the Birmingham and Aston Tramways Co.) being granted to this company for a period of 21 years. The agreement also provides that the Council shall reconstruct the tramways for electric traction. The company has also concluded an agreement with the Erdington Urban District Council which provides for the construction by the Council of the tramways authorised by the Erdington Tramways Act, 1902, on the overhead system, and for a lease thereof to this company for a period of 21 years. These tramways form a continuation of the Aston tramways leased to the company. The agreement also provides that the company shall become the contractors of the Council for the supply of electricity within the district under the Erdington Electric Lighting Order, 1900, for a period of 21 years. The tramway between Small Heath and Yardley (1½ miles), authorised in 1897 and 1901, has now been completed, and is expected to be opened for traffic by electric traction during the present month. The company's tenure of this line has been extended until 1933. The tramways authorised by the Kings Norton and Northfield Urban District Council Act of 1901, along Pershore Road (three miles), to be leased to this company till 1911 are on the point of completion. A notice has been received from the Handsworth Urban District Council for the purchase by the Council of 6 furlongs of the tramways within their area. Negotiations are pending between the company and the Birmingham and Midland Tramways, Ltd., with a view to making an arrangement under the powers of the Birmingham District Tramways Act, 1903, for the joint working of the lines of the two companies, in conjunction with other tramway undertakings in the adjacent districts. The Birmingham and Midland Tramways, Ltd., has acquired controlling interests in the undermentioned tramway companies:—City of Birmingham Tramways Co., Ltd.; Dudley, Stourbridge and District Electric Traction; Co., Ltd.; Wolverhampton District Electric Tramways, Ltd. South Staffordshire Tramways (Lessee) Co., Ltd.

Hove Electric Lighting Co.

The annual meeting was held on Wednesday at Salisbury House, E.C., Col. A. J. Filgate, R.E., presiding.

The Chairman, in proposing the adoption of the report, said that the capital expenditure during the year amounted to £20,610, making the total £147,714. About £16,500 of the outlay during the year was on the new generating station and its plant. That station was brought into use at the end of November, and was of considerable assistance in dealing with the heavy winter load. The expenditure on mains and feeders amounted to £3,968. It was estimated that the further sum needed to complete the new station and the plant under order would be about £5,000. In order to provide the necessary capital they issued £8,230 additional debenture stock, increasing the debenture issue to £44,600, and they offered to the shareholders 2,000 new shares at £7 10s., all of which were at once taken up. The number of houses on the system at December 31st was 1,148, an increase during the year of 108 houses. At the close of the year the lamps and motors connected reached the equivalent of 77,366 8 c.p. lamps against 69,924 at the end of 1902, an increase of 7,442, and the units sold to consumers during the year amounted to 779,985 compared with 735,316, an increase of 44,669 units. The gross revenue was £19,035 an increase of £1,473 over 1902. The working expenditure was £7,820 against £7,519. The coal bill shows a reduction owing to their contract being at a lower figure. The net revenue of the year amounted to £11,214, an increase of £1,171 over 1902. With the balance brought forward, and interest on deposits, the amount they had to deal with in the profit and loss account was £11,482. From that had to be deducted interest on debentures, loans, and calls paid in advance, £1,777, the interim dividend paid last October and income-tax, which left a balance of £7,100. They recommended that £3,000 be placed to the credit of the reserve account, £500 to the credit of the maintenance reserve account, and that a final dividend at the rate of 10 per cent. per annum for the half-year be declared, making, with the interim dividend, 8½ per cent for the year. During the past two years they had had to face a serious task which had been a severe test of the value of the undertaking; they were forced to embark on the construction of the new generating station in order to cope with the increasing demand for electricity in Hove. In the two years they had expended nearly £38,000 additional capital on the undertaking, and had been able to do this while maintaining a dividend of 8½ per cent. and placing £5,500 out of revenue to the reserve fund in the same period. Their plant was now sufficient for some time to come. When they met last year he told them that they had not yet heard from the Board of Trade regarding their application to be authorised to supply all their customers at 220 volts. After considerable delay they were invited to meet the officials of the Board of Trade with the officials of the Hove Corporation, when endeavours were made to arrive at an amicable settlement, but owing to the attitude assumed by the Corporation, such settlement was not then possible. Matters remained still in the same position, save that the Corporation had withdrawn their objection to the incidence of the cost of the change-over, and had fallen in with the course adopted by the company. That brought them much closer together, and it seemed possible they might shortly come to terms. They were most anxious to work in harmony with the Corporation, and would do all they could to come to an understanding with them. The Hove Corporation had asked the company to quote terms for bulk supply to Aldrington.

Col. H. Wood, C.B., seconded the motion, and the report was adopted.

Oxford Electric Co.

Sir Henry C. Mance presided at the annual meeting held on 4th inst. He said that this was a record year with the company, it being the first time that they had generated more than a million units in the year. After providing £2,041 for debenture and other interest, and writing off £623 15s. on account of hire-purchase instalments, the balance available for dividend was £7,880 10s., which they proposed to appropriate as follows:—A dividend at the rate of 6½ per cent. per annum on the share capital ranking for dividend, whereof 2½ per cent. was paid in September last, £4,550, and in adding £2,500 to the reserve and renewal of plant account, which will then amount to £7,000. The balance of £830 10s. is carried forward. The number of lamps added to the system during 1903 was the equivalent of 9,747, making the total connected 55,000 8-c.p. lamps. About 4,700 additional lamps were installed in the various colleges, 1,750 were added in the shops, while private houses,

schools, hotels and offices required an additional three or four thousand lamps during the year. The number of customers had increased by about 100. The increase in the number of lamps was principally due to the additions in the colleges, but the installations in other quarters, such as business premises and private houses, had been very satisfactory. The capital expenditure during the year was higher than anticipated, in consequence of the unusual increase in business. They had expended on capital account £3,549 more than received. There was no finality, they would understand, about the capital account of an electric light company. They were bound to meet the public demand wherever possible, and it was not always easy to foresee from what direction this demand would come. A call for some additional capital would be made towards the end of the year. After referring to the additional sub-stations and mains expenditure, the speaker drew attention to the favourable coal figures obtained, as, although they generated some 100,000 units more than in 1902, the coal bill was about £30 less. Their load factor was not a high one; indeed, if they were to keep their machinery running for one month continuously, they could generate all the current required by Oxford during the year. The directors had placed a substantial sum to the reserve and renewal of plant account—viz., £2,500, bringing this fund up to £7,000. This sum, in the opinion of the directors, was a reasonable provision for depreciation, obsolescence and replacement of plant where necessary. As the engine room was now fully occupied with machinery, and they were getting cramped for room, they proposed during the present year building an additional bay.

The report was adopted.

County of London Electric Lighting Co.

Mr. J. B. Braithwaite, jun., presided at the meeting held at Winchester House, on March 14th. In moving the adoption of the report (Electrical Review, March 11th), he said that the record was one of quiet, steady and satisfactory progress. The capital expenditure during the year was £133,772 (£16,715 on lands, £8,165 on buildings, £43,021 on machinery). They had now put in sufficient plant to carry them over next winter. They had taken the opportunity of securing means for extending the City Road station, should that ever become necessary. Considering their large areas and that they had to serve a demand for power which was growing, it seemed desirable, even at some present sacrifice, to make sure that they would have the means and opportunity of extending at City Road whenever the time came. Expenditure on mains had been £45,272, and that was an item that must continue to be a heavy item for some years because of their large area. Their mains expenditure during the last few years had been quite justified by results. Before they made extensions they always saw to it that the customers secured would give them a return of 20 per cent. gross upon the outlay. They had spent on transformers, motors, &c., £4,874; meters, £7,444; switchboards and electrical instruments, £2,281, &c. The preliminary expenses had been increased from £15,000 to £28,612, the cost of the issue of £250,000 debenture stock having had to be debited to that account, whilst the premium received from it was credited on the other side. They had written off that item £6,245, leaving the figure at £22,366. Turning to the revenue account, they had cause for quiet and modest satisfaction. There was nothing to be enthusiastic over; at the same time their progress was steady and well maintained. The receipts from the sale of current amounted to £105,316, which was an increase of £13,071, or at the rate of 13·6 per cent. The generating expenses had increased by only about £1,000, so that they had made £11,724 of the increased profit from the London stations as compared with last year. That meant that the ratio of working expenses had again gone down. Last year the ratio was 36·4 per cent.; this year it was 33·1 per cent., showing a reduction of 5·3 per cent.; and he thought they might look forward to a small further reduction. Last year he told the shareholders that the working expenses had now got down to a figure where, from the very nature of things, the margin left for further reduction was small. At the same time, during the past year they had no doubt suffered, especially on the south side of the water, from the disturbance and disorganisation which was almost inseparable from a station where there was a large amount of new plant being erected, and building operations going on. That had now pretty nearly come to an end, and he hoped that their station engineers would be reducing the costs to the lowest possible point. He thought they might look forward to a further reduction of a few per cent. The units sold in 1903 showed an increase of 886,348, compared with an increase of 517,180 in 1902, and that was in spite of the fact that their old friend King Fog seemed to have packed up his traps and departed from London. If next winter he returned it would be a sort of windfall for the company. Last year's lamp additions constituted a record for the company; the increase was 112,564 8-c.p. lamps (equivalent), compared with 90,314 increase in the previous year. A considerable portion was due to applications for motive power. They had 595 power customers, with 5,837 h.p. aggregate, of which 1,413 had been added during the year. Motive power supply was making its influence felt, and the new sliding scale of charges for motive power which they had adopted, giving their customers reductions varying from 5 to 30 per cent., according to the quantity, had brought motive-power within the reach of power users. After briefly comparing their position with that of the other London companies, the chairman referred to the reorganisation of the Scottish House-to-House Co., which was now earning a profit. The profit on investments realised showed a decrease, which was due to the fact that last year they had included in that item between £6,000 and £7,000, part of the profit realised upon the sale of their shares in the Dover Electricity Supply Co. It was gratifying that this year, in spite of their loss of that exceptional source of revenue, their total income showed an increase. The net result was that they were able to pay the same dividend as last year, and to carry £2,000 more to depreciation. The provision made for depreciation was totally inadequate at present. They could only make provision as they had the funds to do it. They hoped to be able to increase the amount year by year, until it reached an adequate figure. Their trouble, with regard to municipal authorities had, for the moment, vanished. Since January 1st last they had received applications for the equivalent of 26,872 8-c.p. lamps, as compared with 15,040 for the same period last year, showing an increase of 78 per cent. After making the necessary deductions in respect of adjustments and disconnections, the actual net increase was 17,428, as compared with 7,842, showing an increase of 122 per cent. They must not go away with the impression that they were going to have an increase of 122 per cent.; that would mean more than doubling the lamp connections, and they would not have plant to supply them; but the business was still coming in at an accelerated rate. The sale of units up to the week ending March 8th was 1,521,524 units—an increase of 216,036 over last year, and there was an increase of 123 per cent. in the number of consumers.

Mr. Reynolds seconded the motion.

Some criticism was offered by Mr. Hitchin of the inadequacy of the provision for depreciation. It was the ninth or tenth year of the company's existence, and it was quite time that the amount of depreciation should be in proportion to the capital expenditure. A shareholder in need of enlightment tried to show that the company's progress (net profit) was not so great as might be supposed. He also urged the necessity for keeping down the capital account, apparently forgetting that he was at the meeting of a progressive electric lighting company, and also apparently forgetting the very remarkable figures of increased demand which had been so plainly laid before the meeting by Mr. Braithwaite.

The Chairman replied that the provision for depreciation *was* ridiculously inadequate. At the same time the shareholders were entitled to some consideration; but though they had the prospect of steadily improving the profits, he must warn the shareholders not to expect to receive any substantial increase in the dividend until the depreciation fund was in a more satisfactory position. In regard to the remarks about capital expenditure additions, they were not extravagant in any way, but every penny of additional capital earned them 10 to 15 per cent. profit.

The report was adopted

Subsequent resolutions approved the alteration of the name of the company from the County of London and Brush Provincial Electric Lighting Co., to the County of London Electric Lighting Co., re-elected directors and auditors, and thanked the chairman, board, officers and staff (Mr. Sparks, the chief engineer, and Messrs. Dale and Whitlock, the station engineers, receiving special mention).

Brompton and Kensington Electricity Supply Co.

The ordinary general meeting of the shareholders of this company was held on Thursday of last week, at Winchester House, Old Broad Street, E.C., Mr. H R. Beeton presiding. The Chairman, in moving the adoption of the report (Elec. Rev., March 4th), said it was satisfactory to note that in the fourteenth completed year of the company's existence the increase in the number of lamps connected was larger than in any previous year of its history, and it was also satisfactory to note the growth in the net revenue during the past year, despite the absence of fog. That result was in part due to demand for power, which had increased from 18,000 units in 1902 to 100,000 units last year, and they had every reason to hope that that increase would continue. Speaking generally, both the capital and the revenue showed a normal increase in all items due to the growth of the business, but it was satisfactory to note, that although they had spent £56,000 during the last six years on new plant, the capital had only increased by £9,000, the balance having been met by the appropriation to depreciation and by undivided profits. It was also very satisfactory to note that the total cost per unit generated was the lowest yet reached, notwithstanding that the cost of coal was not lower than in 1898, and notwithstanding also that the expenditure on repairs and maintenance had been exceptionally heavy, amounting to £1,961, as compared with £759 in the previous year. As illustrating the improvement in the company's position, both as regarded capital and revenue, he would like to call their attention to the fact that during the last 10 years the units sold had risen from 400,911 to 2,322,231; that the efficiency of distribution—the units metered as compared with the units generated—had risen from 42 per cent. to 83 per cent.; that the total cost per unit has decreased from 4·34d. to 2·17d.; that the load factor had risen from 10·46 per cent. to 15·44 per cent.; that the net receipts had increased from £6,264 to £29,234; that the percentage of net profit had risen from 7·4 to 12·5; and that notwithstanding that the average price obtained had fallen from 7·53d. per unit to 4·96d. per unit, and that the annual appropriation for depreciation had steadily risen from 1·72 per cent. of the capital to 3·21. The grand result of all that was that from distributing no profit they were now able to distribute 10 per cent. Roundly speaking, the directors had had at their disposal for distribution from net profits and premiums on capital issues about £220,000, and of that only about a half had been distributed as interest and dividends, the remaining half having been invested in the undertaking in one form or another. He thought the shareholders would agree with him that that was a very sound position, and would consider that it justified the policy which the directors had systematically adopted. Referring to the proposed appropriation of the balance of net revenue account, it would be noted that they recommended carrying forward the large

balance of £4,179, which course was rendered prudent, in their judgment, from the fact that the price of current to consumers was being reduced in the present year. They had issued a circular announcing that the maximum price would be reduced from 6d. to 5½d. per unit, with rebates according to the quantity taken; and, although they felt sure that ultimately it would tend to benefit the company, the immediate effect might be to introduce a slight element of disturbance into the accounts. In view of the substantial reserve, amounting to upwards of 22 per cent. of the capital, and the satisfactory rate of dividend to which they had now attained, the directors proposed, with the concurrence of the shareholders, to avail themselves for the first time in the history of the company of their rights in regard to remuneration under the articles of association, and in view of the large amount which they had waived up to the present time, amounting to some £10,000 or £12,000, they trusted that the course they proposed would meet with the approval of the shareholders.

Mr. W. Page, in seconding the resolution, remarked that although the company had developed an enormous business, they were still only supplying 3,326 consumers in the district. He should say there must be at least 10,000 or more possible consumers in their district, so there was plenty of scope for extension.

The report was adopted.

The retiring directors were re-elected, and votes of thanks were accorded the staff, and the chairman and directors.

Metropolitan Electric Supply Co.

Mr. W. H. Cripps presided at the meeting of this company held at Winchester House on Tuesday. In regard to the year's capital expenditure (£244,000), £33,000 was spent in Marylebone, and would be repaid to them. The great bulk of the expenditure was at Willesden. Capital expenditure in electric lighting companies must vary from year to year; they had to put in plant for some years ahead. The money spent at Willesden would without any large further expenditure bear fruit for a good many years to come. The first wing of the power station contained 22,500 H.P. of machinery, all in perfect working order. They did not grudge spending money there, because it was outside the Electric Lighting Acts of 1888; it was their freehold, and they had not got to hand it over to any jealous borough councils at the end of that time. Then they were free there from the annoyance promoted by neighbours who said that the works shook their nerves or disturbed their sleep. Of the half million preference shares, two-thirds were taken up by their existing shareholders, and the other third had been disposed of from time to time at a fair and substantial premium when the money was required. In future the preference dividend would be paid regularly on July 1st and January 1st, commencing with next July. The bank loans had been reduced from £390,000 to £210,000, and they would very easily wipe off that loan when they were paid some of the large sums of money that were owing to them. The revenue during the year 1903 was £281,000, or £20,000 increase. He did not think that they could reckon upon these large increases in the future; as the various areas became more or less filled up, the new demands would not be so great as they had been in the past. The cost of generation was £98,000, that was to say, they had saved £15,000, although they had sold £20,000 worth more electricity. That great reduction in cost was almost entirely due to cheap working at Willesden, partly due to the actual improvement of the machinery, and in no small measure due to the care exercised by Mr. Highfield, their chief engineer, and Mr. Markby, the resident engineer, and all the engineering staff to secure economical production. He also wished to refer to their indebtedness to the secretary, Mr. Owen, and to their extremely able general manager, Mr. Conacher. The speaker then explained the manner of dividing the balance available, as shown in the report (Electrical Review, March 11th), and referred to the increase of the dividend from 7¼ per cent. for 1902 to 8¾ per cent. for 1903. In regard to the general position of the company, they had had to fight right from their birth. A large section of the community regarded an electric lighting company in the light of a criminal to be prosecuted in every possible way. This year they had spent a good deal of their time before Arbitration Courts and in the Law Courts, and had not been altogether unsuccessful. They had to sell Sardinia Street station to the L.C.C., and the arbitrator had awarded them £183,000, which they considered a fair and reasonable award for that station; but they had not yet received the money. Public bodies were pleased to incur debts, but not so ready to pay. In addition to the £183,000, they had had a new site given to them of area equivalent to that given up in the old slum. That was a nice and comfortable exchange, and whether they would erect a station on the site or sell it, must be subsequently considered. In regard to Marylebone, he was on tender ground. For a great number of years, after persecuting the company in every possible way, the Council at last got the compulsory order to buy them. The award was given before the last meeting, but, like a good many private people, when they had bought something that they did not want, and had overspent their capital, they looked about among their friends to see if they could get someone to borrow the money for them. The Borough Council had not found anybody sufficiently confiding to lend the money. The directors had contended all along that all that difficulty in raising money was not necessary. Had there been a *bonâ fide* intention to raise the money it would have been done without any difficulty. Affairs had got to that stage that it appeared necessary for the Borough Council to go to Parliament for a Bill to enable them to borrow the money from someone. He believed that this measure would be considered next week, and he hoped that the Council would find an easy way of obtaining the money with which to pay their debt to the company. Their position was a very curious one at the present time. They were bound by their statutory orders to carry on the supply in Marylebone, although the concern did not belong to them. They were carrying it on for the Council, who thought that the company would not only carry on the undertaking for them, but do so with their own money. The company, however, sought the assistance of his Majesty's Courts, and got a very satisfactory judgment from Mr. Justice Buckley. His Lordship did not see why they should pay the capital expenses for carrying on someone else's business. The result was that they got an order by which the Council had to pay the company £60,000 down as part of the expense already incurred. This amount had since been paid into their account. The Council had been anxious to gain more time to see if they could get a little more money, and an extension of time for paying the award was granted on the condition that they paid the company certain sums from time to time; and accordingly a further sum of £15,000 would be due to them by the end of this month. The Council approached the company as to whether they would make an arrangement to cancel the award. The directors would enter into no negotiations unless the award money was paid. The Council had now got that thoroughly at heart. Among other remarks made by the chairman were some to the effect that negotiations had been entered into between them to see whether terms could be arranged, after the amount awarded to the company had been paid, by which they would supply the Council wholesale from their station at Willesden. They knew that they could do this very much cheaper than the Council could do it for themselves. To obtain their own supply would mean putting up an entirely new station at a cost little short of £500,000, and they would also have to spend many thousands of pounds in disconnecting the present system in Marylebone, which was connected at Willesden all ready for the supply. He contended, moreover, that this money would be expended uselessly, except for the pleasure of doing a little municipal trading. Suggestions had been made by the directors for a lease of the concern for the Borough Council, but he did not know whether these suggestions had been considered. They had been negotiating with other companies as well; and, indeed, it seemed to him that they had been casting about over both Europe and America to see what sort of supply they could get. He did not know whether the Council had completed the negotiations, but he did know that, being actually connected with them, and having their station at Willesden, the company could afford to supply them as cheaply as, if not cheaper than, any one else.

The report was adopted.

The retiring directors and auditors were re-elected, and the board and management were congratulated upon the firmness with which they had carried through the Marylebone negotiations to their present successful stage. A vote of thanks to the board, officials and staff closed a very cordial meeting.

W. T. Henley's Telegraph Works Co.

Mr. S. Gedge presided at the meeting held last Friday at the new premises in Blomfield Street, E.C. In moving the adoption of the report, he said that there were many things upon which they might congratulate each other at that meeting. They had come into possession of the new offices, and felt the benefit. The works were in very good order; there had been no accident worth remembering during the year; there had been no reduction from the Bahama cable repair fund, and 13 out of the 20 years had passed, and at the end of seven more the company's liability would be at an end. They had paid £50,000 for the 12 acres on the riverside for the new works. The whole of the new capital, ordinary and preference, had been taken up by shareholders, with the exception of allotments to one or two large customers. The issue had been made without any expense. Although last year's business showed a diminution, the first two months of 1904 had shown a very considerable increase in the amount of good business. They had paid 20 per cent. for the previous three years, but this year it was 15 per cent.—a substantial dividend—though they could have paid the 20 per cent. fairly and honestly, but they did not believe in dividing profits up to the hilt. The chief cause of the reduced dividend was keen competition. It must be borne in mind by those who wished to start rival works that the dividend had not always been large. If they examined all the dividends since the commencement of the company they would find that the average worked out at rather under 6¼ per cent, and that had been paid upon the ordinary capital only. More than half of their capital had been raised at 4½ per cent., and therefore taking it all round, there had been barely 5½ per cent. paid since the formation. Another cause of the reduced dividend was the general depression following the war. Again, municipalities who were very good customers, could not now borrow money at less than 4 per cent., and those who had the management of municipal funds were not branching out in electrical schemes until money was easier. Last year's output of gold was in excess of any previous output, and as this went on from year to year, it would tend to improve business and make money cheaper, and "set things humming," so that Henleys and others would benefit. The plans for the new works were approved, and they might be ready for opening by the end of the current year. Increasing business and increased responsibility led the directors to propose additions to the board and to the fees for that purpose. The company had now a child called the South African Co. They had written down for depreciation of machinery by £300 more than last year, and had carried forward to reserve £2,000 more. The secretary (Mr. Salmon) had paid a visit to Australia and set in order some things that required attention there.

Mr. G. Sutton seconded the adoption of the report, and he said that he was satisfied with the progress of the company in relation to that of other large concerns in the country. He did not think they

need look forward to decreased profits in the future. The last six months of the electrical trade had been the worst time he had known. Since 1901, trade had been gradually falling away. During the booming years works were extended, and subsequently endeavours which were made to keep machinery employed, had the effect of reducing prices. In all departments, save one, this company had shown a profit during the year, and the difficulty in regard to that one exception would be got over, and it would show a profit during the current year. He hoped they would some day be able to get municipalities to see the error of their ways in keeping back 10 per cent. of the contract sum for six and sometimes 12 months. They ought to be satisfied, as Government departments were, when dealing with reputable firms, to pay up when the contract was completed. For other companies which were doing a larger business with municipalities, the matter was becoming a very serious burden, such large sums remaining outstanding, waiting for the termination of the retention period.

The report was adopted, and the other resolutions relating to dividend, re-election of directors and auditors, and the increase of directors' fees, were carried unanimously. A hearty vote of thanks to the staff, officers, and board, brought the meeting to a close.

Edwards Air Pump Syndicate.

THE annual report for 1903 states that the royalty income for 1903 amounted to £7,493, as compared with £4,792 for 1902—an increase of £2,701.

The ordinary expenditure was £3,128, being an increase of £563 on the previous year. The royalty increase is due to a larger number of pumps being fitted to land installations and to the steady development of the foreign business of the syndicate. As steam turbines are being largely used for marine propulsion, and also for the generation of electrical power, special attention has been paid to the design of pumps for use in connection with this type of engine. The balance on the revenue account for the year amounts to £4,618, and adding the balance brought forward from last year, the total is £4,784. The directors propose applying this balance as follows:—To place £3,000 to sinking fund account, for redemption of cost of acquiring patents, and to pay a dividend of 10 per cent. on the called-up capital, leaving to be carried forward £663.

Chelsea Electricity Supply Co.

THE annual meeting was held at Winchester House last Friday, Mr. J. IRVING COURTENAY presiding. In moving the adoption of the report (see ELECTRICAL REVIEW, March 4th), the chairman congratulated the shareholders on the improvement in the company's business, the profit for the year being £33,055, as against £27,989 last year, enabling a dividend of 5½ per cent. (1 per cent. more than last year) to be paid. A further reduction in the working costs per unit was effected and was chiefly due to economies facilitated by the greatly increased demand. The total cost per unit only amounted to 1·90d. as against 2·38d. for 1902, which reflected great credit on the engineer. The increase was due rather to the adoption of electricity for motive power, heating, and charging the batteries of electric carriages. 19,233 lamps were added during the year, as compared with 14,971 added during 1902—the total lamp connection at the end of the year being 195,235, while the units sold per lamp show an increase of 1·25 for 1903, the total units sold during the year being 581,793 more than the previous year. The capital expenditure on plant during the year had not been heavy. Further progress had been made during the year in the direction of extending the system of mains which supply current direct from the generating works, thus obviating the cost of additional transforming plant, and the losses which must necessarily occur in sub-stations for transformation. The work of changing over to the 200-volt supply the earlier customers, who were originally supplied at a pressure of 100 volts, had made great progress. They hoped before long to complete this work over the whole of the area, and to supply all customers at one uniform pressure. They had had an artesian well bored at the generating works, and they now had an ample supply of good well water for boiler feeding. The company paid in rates, £3,073 (nearly 22 per cent. of the amount of the dividends and nearly 1½ per cent. on the ordinary shares). The actual fresh capital expenditure during the year was only £16,033, of which a little over £2,000 was on land and buildings, and the remainder on plant, mains and accessories. The suspense account was composed entirely of the cost of changing over from 100 volts to a pressure of 200 volts. There would be some more expense under this head in the next accounts, but they hoped to complete the change during the present year. At the last annual meeting mention was made of a scheme for the cancelling of the founders' shares and giving the holders an immediate participation in the profits by means of income certificates. That scheme did not appear to have commended itself to the holders of founders' shares, and a conference on the subject with a committee of the founders' shareholders was held a few weeks ago. He could put nothing definite before the shareholders at that meeting, as some discussion, and an agreement as to terms, were necessary before proposals could be properly formulated. The representative of one of the largest holders was away from England for some weeks, and on his return they hoped to again meet the committee, and would endeavour to arrive at a basis of agreement. Such further action as might be deemed advisable and necessary would then be taken to obtain the approval of the shareholders, and notice of a Bill in Parliament would have to be given in the autumn. It would be to the advantage of the general body of shareholders that the founders' shares should be extinguished on proper terms, and he thought the holders of founders' shares would see that it was to their interest to settle on fair and reasonable terms—that was, on such terms as the holders of ordinary shares would be ready to sanction. He then formally moved the adoption of the report and the declaration of the dividend.

Major-General WEBBER seconded.

After some questions had been put to the meeting and various remarks made by founders' shareholders, the report was adopted, with six dissentients.

The retiring directors and auditors were re-elected, and a vote of thanks closed the meeting.

Bournemouth and Poole Electricity Supply Co.

THE report for 1903 says that the business continues to make satisfactory progress. The total applications received at December 31st last amounted to the equivalent of 100,538 8-C.P. lamps, being an increase of 19,542 8-C.P. lamps for the year, as compared with an increase for the previous year of 13,343. The total number of Board of Trade units sold for lighting, power and traction purposes was £1,520,002, being an increase of 259,736 units for the year.

The capital expenditure during the year in respect of the Bournemouth Order, 1890; the Poole and Branksome Order, 1897; the Christchurch and District Order, 1899; and the Pokesdown Order, 1902, amounted to £55,433, making the total expenditure to date in respect of these orders £286,490. The balance to the credit of net revenue account, including the amount brought forward from last year, and after payment of all interest and other charges, reserve for depreciation and redemption funds, is £12,960. Out of this sum, the dividends on the 4½ per cent. and the 6 per cent. preference shares have been paid, and the directors now recommend the payment of a dividend on the ordinary shares of the company at the rate of 8 per cent., less income-tax, for the year ended December 31st, 1903. These payments will absorb £9,655, and leave a balance of £3,306 to be carried forward. To meet the increasing growth of the company's business, additional generating plant has been erected at the company's station in the Bourne Valley, and this the directors anticipate will be sufficient for the company's requirements for the next few years. The generating station at Christchurch has been completed during the year, and a supply therefrom was available for both lighting and traction purposes in June last. The company has secured a contract from the Christchurch Borough Council for the electric lighting of the public streets. The company's mains have been extended to Pokesdown under the provisions of the Pokesdown Electric Lighting Order, obtained in 1902, and a supply of current was available there early last year. The Richmond (Surrey) Electric Light and Power Co., Ltd., has made satisfactory progress during the past year. The directors of that company have declared a dividend upon its ordinary shares at the rate of 7 per cent. per annum in respect of the year ended December 31st last.

STATEMENT OF ELECTRICITY GENERATED, SOLD, &c.

Units generated.	Quantity sold.			Used on works.	Total accounted for.	Not accounted for.	Public lamps.	Maximum supply demanded.
	Public lamps.	Private consumers by meter.	Total sold.					
1,987,809	10,802	1,448,597	1,459,399	220,265	1,679,664	308,145	110	1,485 KW.

Tynemouth and District Electric Traction Co.

THE directors' report for 1903 says that the capital expenditure during the year was £4,158, the total capital outlay on the electrical construction and equipment of the lines being £85,314.

The total revenue for the year amounted to £16,128, and the expenditure to £10,036, leaving a profit of £6,102, which, added to the amount of £188 10s. 3d. brought forward from last account, leaves an available balance of £5,178 after deducting the preference dividend paid to September 15th. The directors recommend that £1,500 be placed to depreciation and reserve fund, that 5 per cent. per annum be paid on the preference shares from September 15th to December 31st, 1903, = £457, and 7½ per cent. on the ordinary shares for the year = £3,000, and that £240 be carried forward. The directors hope to make arrangements for the construction and equipment of the light railway to Whitley Sands during the coming summer season. The capital is to be increased by the creation of 4,000 ordinary shares of £5 each, in order to provide for increased services, the development of the undertaking, and to replace revenues expended on capital account. Although the weather during the past year has shown little, if any, improvement over that experienced during 1902, the traffic receipts have increased by £760.

	Year ended Dec. 31st, 1902.	Year ended Dec. 31st, 1903.
Miles open—		
Route miles	3·71 miles	3·71 miles
Single line	1·16 "	1·16 "
Double line	2·55 "	2·55 "
Number of passengers carried	2,417,875	2,516,351
Average receipts per passenger	1·50d.	1·53d.
Average expenditure per passenger	·96d.	·95d.
Proportion of expenses to receipts	64 %	62 %
Number of cars in stock	22	22

Davis & Timmins, Ltd.

THE report for 1903, which was submitted at the meeting on Monday, states that net profit for the year, including £2,891 brought forward, after allowing for depreciation and commission to managers, is £12,821. The interim dividend paid in September last on the preference shares absorbed £1,800, leaving a balance of £11,021. The directors recommend a dividend of 8 per cent. on the ordinary shares for the year, placing to general reserve £2,000, and carrying forward £3,461.

Sir HENRY MANCE presided at the meeting held on Monday at Winchester House. He thought that bearing in mind the trade conditions of the last year or two, the results of 1903 were very encouraging. They had at present 3,000 ordinary shares still unissued, and that prevented a Stock Exchange quotation being obtained, but if they had to extend the Wood Green factory, that money would be needed. Trade throughout the country had not generally improved, and competition had been very keen. £1,746 had been written off for depreciation of plant and machinery. They were hoping that some revival would come during 1904. He mentioned that while there had been a slump in the prices of a large number of securities, the shares of Davis & Timmins remained at the same figure as last year.

The report was adopted, including an 8 per cent. dividend declaration.

Oldham, Ashton and Hyde Electric Tramway Co.

The directors' report for 1903 gives the total revenue for the year as £30,451, and the expenditure (including £1,600 for debenture interest) to £23,567, leaving a profit of £6,884, which, added to £124 brought forward from the previous account, makes an available balance of £7,008 19s. 11d., which the directors propose should be applied as follows:—

Depreciation and reserve fund	£1,000
5 per cent. dividend on the cumulative preference shares ..	2,419
Dividend on the ordinary shares at the rate of 9 per cent. per annum for the last six months, making with the interim dividend 7 per cent. for the year	3,419
Balance carried forward	170
	£7,008

The reduction of the dividend on the ordinary shares by 1 per cent., is due to the distress in the cotton industry, the unfavourable weather experienced throughout last year, and a loss on the joint working by the company and the Stockport Corporation of the new line from Hyde to Bredbury.

The subscribed share and debenture capital of the company is £140,000. In the course of the year £14,918 was expended, mainly on the equipment of the Hyde-Bredbury extension, and the total capital expenditure to December 31st, 1903, amounts to £150,327. The directors have power to issue further debentures to the extent of £10,000, but it is not intended to make an issue at present. During the past year 500 ordinary shares and 500 5 per cent. cumulative preference shares of £10 each have been issued to the shareholders and paid for in full. The total premiums received in respect of this issue amounted to £1,250, and after deducting the expenses of issue, viz., £7, the balance of £1,243 has been placed to depreciation and reserve fund, which with the addition of the £1,000 above recommended, will stand at £8,748.

1902. M.	F.	C.	Route miles—	M.	F.	C.	1903.
5	6	7	Single line..	6	3	9·6	
2	2	4	Double line	2	5	0·4	
8	1	1		9	1	0	
5,242,648			Number of passengers carried	5,570,486			
1·27d.			Average receipts per passenger	1·28d.			
0·84d.			Average expenditure per passenger ..	0·90d.			
66·14 %			Proportion of expenses to receipts ..	70·31 %			
46			Number of cars in stock	46			

Windsor Electrical Installation Co.

The report for 1903 shows a steady increase in the business. During the year 2,648 lamps of 8 C.P. were added, bringing up the total to 27,886, of which 2,362 represent the motor power.

The capital expenditure during the year amounted to £2,623. After crediting the account with £680, being the cost of machinery sold to the Slough and Datchet Co., the total expenditure is £64,844, the principal increase being £1,998 on new mains, including additional feeder cable laid in Thames Street, and distributing cables at Eton College and Windsor. The net profit for the year, after providing £719 for interest on borrowed capital, is £5,051. The total amount of profit available for distribution is £5,090, and out of this the directors recommend that the sum of £1,000 be added to the depreciation, renewal and reserve fund, bringing this fund up to a total of £8,070. An interim dividend of 2½ per cent. was paid by the directors during the year, and they now recommend that £100 be transferred to the net revenue account from the dividend equalisation account, and that a further dividend, at the rate of 5½ per cent., less income-tax be declared, making a total dividend for the year of 8 per cent. The company commenced to take a supply of current from the Slough and Datchet Co.'s generating station on October 16th, and from that date to the end of the year they supplied this company with 11,521 units. The modern machinery at the Slough generating station leads the directors to believe that it will be conducive to low working costs in the production of current. Since the close of last year the directors have accepted a further allotment of 4,000 £1 shares in the Slough and Datchet Co., bringing the total investment in that undertaking up to £14,000.

Slough and Datchet Electric Supply Co.

The first annual report of this company shows that the whole of the first issue of 25,000 shares was taken up.

The company commenced to give a supply of electricity on July 3rd, 1903. The present capacity of the generating station is 510 H.P., and a further set of 380 H.P. is on order. The number of 8-C.P. lamps and motors connected up to December 31st, 1903, was 3,126, of which 422 represented the motor power. The directors recently offered to the shareholders *pro rata* to their holdings a further 10,000 shares, and the whole were taken up. The revenue from sale of current was £606, and adding to this the other receipts, amounting to £411, and deducting the expenses, the net profit amounted to £606. The directors recommend that the whole of the preliminary expenses, amounting to £311, be written off, which will place the company on a very sound basis; the balance, £295, is to be carried forward. The price charged for electricity is 7d. per unit for lighting, and 3½d. for motor power, but the directors have the revision of prices under consideration.

Devonport and District Tramways Co.

The report for the half-year ended December 31st last, states that total revenue for the six months amounted to £13,573. After deducting all expenses chargeable to revenue, there is a profit of £3,687. Adding to this £181 brought forward from previous account, there is an available balance of £3,868. The directors have placed to depreciation and reserve fund £1,000, and recommend a dividend at the rate of 4 per cent. per annum, carrying forward £219. A decrease in general expenses has been effected, although the route mileage has been substantially increased. The reduction in these expenses is principally due to the fact that only a small sum (for costs) is chargeable in respect of the accident in 1902. Experiments with regenerative control having proved satisfactory, the board has decided to proceed with the equipment of the cars. Debentures to the amount of £5,000 have been issued during the half-year, making £11,200 issued to date. The total expenditure to December 31st, 1903, amounts to £154,524. Part of the tramways constructed by the Corporation of Devonport and leased to the company were taken over for working on September 10th, and the remainder on October 31st last.

Direct Spanish Telegraph Co.

The report for 1903 reads:—

After making provision for the debenture interest and sinking fund, the accounts show a balance to the credit of revenue of £10,836. After adding the usual sum of £5,000 to the reserve fund, there remains a balance of £5,836, from which the directors recommend the payment of dividends for the year 1903 of 10 per cent. on the preference shares, and 4 per cent., free of income-tax, on the ordinary shares. These payments will absorb £5,436, half of which amount was distributed on October 1st last as an interim dividend. The remaining balance of £400 the directors propose to transfer to the credit of the contingencies account, which will then amount to £1,180. The traffic receipts show a decrease of £1,798 as compared with 1902, a result due to the interruptions to the cables, and to general depression of trade during the year. The ordinary working expenses show an increase of £95 11s. as compared with 1902. The The Bilbao cable has unfortunately been twice interrupted during the past year, the first interruption, which was mentioned in the last report, having continued for 50 days, bad weather in the Bay of Biscay having delayed the repair. The second interruption occurred on May 12th, 1903, at about 250 knots from the Spanish landing place, but it was promptly restored by the Eastern Telegraph Co.'s cable steamer *Mirror* on May 23rd, the interruption having lasted 12 days. The Marseilles-Barcelona cable was on January 27th, 1903, found to be interrupted at 57 knots from Barcelona, and could not be repaired until February 21st, 1903. The cost of these three repairs, amounting to £10,591, has been charged against the reserve fund. Since the above-mentioned repairs both cables have worked well. Owing to considerable difficulties experienced in working the Bilbao cable in consequence of electrical disturbances at Bilbao, caused by electric trams, &c., it was found necessary, for the proper carrying on of the service, to convert the cable house at Arrigunaga into a cable station, and erect overhead wires into the town of Bilbao. Since the completion of these alterations the service has been carried on more efficiently. The expenditure in connection with this work—viz., £1,467—has also been charged against the reserve fund. At the International Telegraph Conference some reductions of rates in which the company is interested were agreed to:—The rates between Great Britain and Spain, Portugal and Gibraltar were reduced from 3½d. to 3d. per word. The new tariffs, rules and regulations will come into force on July 1st next.

Salisbury Electric Light and Supply Co.

The directors' report for 1903 says:—

The progress made during the year has been very satisfactory. The number of consumers has increased from 369, with 17,657 lamps connected, to 662, with 23,833 lamps connected, the increase being greater than in any previous year. During the year considerable additions have been made to the plant to meet the increased demand. 10,000 new shares and 56 debentures of £100 each have been issued, bringing the share capital of the company up to £30,000 and the debenture issue to £25,600. The profit on the year's working, including £117 brought forward from last account, amounts to £4,489, and after paying an interim dividend at the rate of 4 per cent. for the half-year, amounting to £468, £1,199 interest on debentures and outstanding accounts, and £35 by which the expenses of issue exceeded the amount of the premium received upon the new shares issued, there remains a balance of £2,787 to be dealt with. The directors recommend that a further dividend be paid, making, with the interim dividend already paid, a total dividend at the rate of 5 per cent. per annum for the whole year, and that £1,600 be placed to reserve, leaving £318 to be carried forward to next account.

Mr. W. M. Hammick presided at the meeting on 8th inst., and said that the report was most satisfactory. During the year they had installed an economiser, had extended mains in various thoroughfares, and spent £4,000 more upon free wiring and meters. The auditor had called attention to the fact that nothing was allowed for depreciation, but they had placed £1,600 to reserve which brought that fund up to £2,400; they were thus building up a fund for depreciation and so on, which would be useful in the future. Mr. Gripper seconded the adoption, and said that the year's additions were 300 consumers with about 6,000 lamps. He did not think anyone could really say that they at present wanted a very large sum for the actual depreciation of the value of their concern, because instead of depreciating, their business as a going concern had very much appreciated. The amount of capital they had spent was something over £60,000, and if the business were put in the market, or if it were going to be bought up by the Corporation or anyone else if they had the power, it would be worth very much more than £100,000. So that instead of depreciating, the value was very much greater year by year. At the same time they had to look to the future, for at the expiration of 30 years the Corporation had the power of buying them out at the actual cost of the plant without anything for goodwill or anything of the kind. When that time arrived a sum of money would be wanted for depreciation.

The report was adopted.

Bruce Peebles & Co., Ltd.

The directors' report for 1903 says that the net trading profit for the year, including interest and dividends received, and transfer fees, amounted to £17,126, which, after deducting the sum of £6,125 for directors' fees, managing directors' salaries, income-tax, and interest to vendors, leaves a balance of £11,000 10s., which the directors recommend should be disposed of as follows:—

Dividend at the rate of 6 per cent. per annum, less income-tax, on the preference shares	£2,497 0	
Dividend at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares	2,958 17 11	
Carrying to special reserve fund, as provided by Article 5 of the memorandum of association, a sum not being less than 10 per cent. of the net profits	1,750 0 0	
General reserve fund	1,250 0 0	
Write off preliminary expenses	2,000 0 0	
Balance carried forward	544 11 9	
	£11,000 10 5	

The profit earned is better than last year, which the directors consider satisfactory, in view of the general depression in trade, the consequent reduction in prices, and the fact that the whole of the year's work was carried out in the old premises. The new works at East Pilton are now running, and the directors expect that a considerable saving will be effected in the carrying out of the company's business, as these new works are equipped with the best known appliances for the quick handling of materials. Several large contracts have been entered into on favourable terms, and the present year promises to be very successful.

British Insulated and Helsby Cables, Ltd.

The directors' report for 1903 states:—

The profit for the year amounts to		£129,446	8 4
To which has to be added the balance brought forward from last year		3,468	5 1
Making a total of		£132,914	8 5
From this have to be deducted:—			
Directors' and debenture trustees' fees and remuneration to works committee, less directors' fees receivable from other companies	£2,250 0 0		
Interest on debenture stock	22,500 0 0		
Depreciation on buildings, plant, machinery, &c.	18,500 0 0		
Transfer to special reserve account	8,500 0 0		
Transfer to debenture stock redemption account	5,000 0 0		
Dividend on preference shares to December 31st, 1903	30,000 0 0		
Interim dividend on ordinary shares to June 30th, 1903	20,000 0 0		
		106,750	0 0
Leaving available for dividend a balance of		£26,164	8 5
The directors recommend the payment of a further dividend of 4 per cent on the ordinary shares		20,000	0 0
Making, with the interim dividend already paid, a total of 8 per cent. for the year ended December 31st, 1903.			
Carrying forward to next account a balance of		£6,164	8 5

During the past year the volume of trade has been less and competition more severe. Under these circumstances, the directors consider the result of the year's working satisfactory. The increase in freehold and leasehold property, plant, &c., is accounted for by the completion of the instrument factory at Edge Lane, Liverpool, and the telephone cable factory at Prescot, and other exensions, which are now in working order, and which will enable the company to do an increased business in the future.

Vickers, Sons & Maxim, Ltd.—The report for 1903 says that the return from the various investments standing in the balance-sheet as "interests in subsidiary and connected companies" has been, on the whole, satisfactory. The Wolseley Tool and Motor-Car Co. has given a good return on the sums involved, and the Electric and Ordnance Accessories Co. has been seriously affected by want of orders, and in the case of the latter company also by foreign competition. The expectations expressed in last year's report with regard to the Wolseley Tool and Motor Car Co. have been fulfilled, and there continues to be a large demand for the motor-cars manufactured by them. Their exhibit at the Crystal Palace Exhibition, just closed, attracted much attention and was the means of procuring good orders.

Commercial Cable Co.—The report for 1903 states that the net revenue, including $147,529 brought forward, amounts to $2,656,055, out of which have been paid interest on the bonds and debenture stock ($800,000) and 8 per cent. dividends on the capital stock ($1,200,000), and there has been set aside $350,000 as an addition to reserve fund, and also $150,000 to the fund for insurance of stations, apparatus and repair steamer (which sums will be invested in high-class securities), leaving a credit balance of $156,055 to be carried forward. The reserve fund now amounts to $5,372,520, and the insurance fund to $1,020,862.

British Columbia Electric Railway Co.—The directors state that, for the half-year ended December 31st, 1903, they feel justified in increasing the rate of dividend on the deferred ordinary stock to 3 per cent. The earnings of the company for the half-year were as follows:—Gross receipts, £85,286; working expenses, £46,932; leaving net receipts £38,354, as compared with £29,905 a year ago.

Alley & Maclellan.—The directors recommend a dividend at the rate of 6 per cent. per annum on the ordinary shares for the 11 months ended December 31st, 1903, after deducting £2,737, interest on purchase price; £716, one-fourth of the preliminary expenses; and £2,216 for depreciation of property, plant, machinery, &c., but subject to income-tax and auditors' fees. £444 is carried forward.

Primitiva Gas and Electric Light Co. of Buenos Ayres.—The directors recommend a dividend for the past year of 5 per cent. on the ordinary shares.

London United Tramways (1901), Ltd.—An extraordinary general meeting was held on the 9th inst., when a resolution previously passed at an extraordinary general meeting to approve Bills now being promoted in Parliament, was adopted.

STOCKS AND SHARES.

Wednesday Evening.

Well-advertised purchases of Consols for the sinking fund helped to impart a feeling of strength to the general markets that was not entirely counteracted by the defeat of the Government on Tuesday. The prospect of a dissolution is not anticipated with any pleasure by the Stock Exchange, since it would mean a further contraction of business if men's minds were running upon politics to an unusual extent. At present there is again a little nibbling of the investor at the better-class markets, although the stronger tone in some of the speculative departments can only be called professional.

Of the seven changes in the electrical supply section, three are due to dividend deductions. Several shares, however, have recovered the amount of the distribution, notably City of London Preference and Blackheath Preference. City Ordinary are 10½, *ex* the dividend of 5s. a share. London Electric Preference at 4⅞, and South London Ordinary at 3¼ are both down ¼, the deduction in each case being 3s. Chelsea Ordinary has improved ¼ to 6 middle, on the good showing made by the company: the meeting, which some had expected to be stormy, passed off without much heat being displayed, although one Stock Exchange member rather "sat upon" a section of fellow shareholders who wanted to grumble. Metropolitans are 10s. higher at 18½, Tuesday's gathering evidently creating a good impression. The chairman told the meeting that in certain circumstances it was quite possible that the Marylebone Council might choose to spend a lot of money in erecting a new station and disconnecting the old mains.

We are glad to notice that an evening contemporary is urging upon the supply companies the necessity of providing properly for depreciation. While several of the chief concerns pay commendable attention to this point, there are others which sin grievously in their neglect of this important duty.

Brisk dealings are reported in the new National Telephone 4 per cent. Debenture stock, and the dealers will make a 1 per cent. price in amounts up to £5,000, which is something surprising for such a security. The price this Wednesday evening left off at 94½ for the fully-paid stock. It is understood that underwriters had to take about half the issue; but as they are said to have received the lavish commission of 4 per cent. for their assistance, they cannot be said to have done at all badly. The old 4 per cent. Debenture keeps about par, but the 3½ per cent. stock at 95 shows a point fall. Other issues of the company have not moved.

Telegraph descriptions are as lifeless as ever. Anglo-American Deferred lost ¼ at 7, and China Debenture at 104½ is 1 per cent. lower. Great Northerns have improved the fraction to 24½. There the changes end, and the Trust varieties are equally inanimate. Business has not come to a standstill, but it is not sufficient in volume to affect quotations, the majority of orders in Telegraphs nowadays being for insignificant amounts.

Metropolitan Railway Consolidated is 2 points to the good at 85½, upon the success attending the company's issue of 3½ per cent. Convertible Preference stock. The half million sterling offered was applied for three times over. Complaint was made in Parliament last Tuesday of the overcrowding upon the Metropolitan's extension lines. Mr. Gerald Balfour, in reply, said he had communicated with the directors, and that increased accommodation would be provided when the electrification was completed. We know other lines, not to be electrified, which are worse sinners than the Metropolitan. There is no alteration in Districts at 32, and the purely electrical stocks are all unchanged in price. Great Northern and City Preferred "A" are 7, Piccadilly and Brompton Ordinary 9½, and East London stock is 4⅞. Baker Street and Waterloo Preferred are called 6 to 7 for the £10 fully-paid shares; the company is seeking fresh borrowing powers, and intends to make improvements all over the line.

Traction stocks and shares have little feature of particular interest to call for notice. British Electric Ordinary change hands daily at about 9½, the Preference being a sovereign higher. London United Trams are 11¼, and 102 for Preference shares and Debenture stock respectively. Potteries at 9 have slightly advanced on the dividend declaration. Auckland Electric Tramways 5 per cent. Debenture stock is 99. British Columbia Electric Railway Deferred has risen to 84½, and the Preferred to 99½ upon the increased dividend on the former stock.

An outside broker is vigorously lauding the attractions of Kalgoorlie Electric Power and Lighting Preferred shares, the price of which is about 8s. 6d., and while all that their champion says of their merits may be quite true, it always seems rather a pity that the advantages possessed by any share should have to rely upon this kind of aid for their appreciation by the public. Of course the investment is a highly speculative one, and unless we are greatly mistaken, somebody wants to sell shares at the present time, which may conceivably cause the price to go lower.

Amongst Industrials, Telegraph Constructions are 16s. better, allowing for the dividend, but General Electric Preference has eased off a little to 9¼. Henley's Preference at 5¼ are the dividend of 2s. 3d. harder, and the Debenture stock at 109 has risen a point. British Westinghouse Preference were done as low as 3⅛ on Tuesday. The 4 per cent. Debenture stock is 94½ and British Thomson-Houston 4¼ per cent. Debenture 102. Willans & Robinson are quoted at 3¼ and 5, Babcock & Wilcox 2⅞ and 1½ for Ordinary and Preference shares respectively in both instances. British Insulateds are unaltered upon the declaration of a 4 per cent. dividend, making 8 per cent. for last year, and Henley's keep steady.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations March 9th.	Closing Quotations March 16th.	Business done week ended March 16th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	98¾	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	70 — 80	..	..
738,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	48 — 51	48 — 51	48⅛	48
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92⅛	91⅛
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7 — 7⅛	6⅞— 7⅛	7	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	180 —190	180 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 91	89 — 91	91	..
16,000	Cuba Telegraph	10	4 %	6½%	..	7 — 8	7 — 8	7⅞	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	..	2⅛— 3⅛	2⅛— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅛— 8⅛	7⅛— 8⅛	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9⅜— 10¼	9⅜— 10⅜	10⅛	10
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	117 —122	117 —122	119¾	117½
1,955,555	Do. 5½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	..	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	105⅜	104½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10⅜— 11¼	10⅜— 11¼	11 1/16	10⅜
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	103 —106	103⅜	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	98 —101	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5¼%	..	..	8⅛— 8⅜	8⅛— 8⅜	8⅛	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 12½	12 — 12⅝	12 1/16	12⅜
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	..	23½— 24½	24 — 25	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	..	38 — 41	38 — 41	40½	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —103	100 —103	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	99 —101	99 —101	100⅜	99
1,966,667	Do. do. Def. Stock	100	..	4½%	6 %	73 — 76	73 — 76	74	73
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13½— 14½	13½— 14½	13¾	13½
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5⅛	5 — 5⅛	5	..
000,000£	Do. do. 5½ % Deb. Stock Red.	Stock	5½%	5½%	5½%	95 — 97	94 — 96	95⅜	94
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	99 —101	99 —101	99⅛	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6⅞— 7⅛	6⅞— 7⅛	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	115 —120	115 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅞— 6	5⅞— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	2 %	..	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11½— 12½	11½— 12½	12⅝	11⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	101	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4½— 5½	4½— 5½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	100	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4 — 5	4 — 5	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	87 — 91	89 — 94	91	90½
100,000	British Electric Traction	10	9 %	8 %	..	9 — 10	9 — 10	9⅝	9 1/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10 — 11	10 — 11	10⅝	10 1/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	121¼	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	6 — 6¼	6 — 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —107	102 —107	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	9/16— 11/16	9/16— 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	⅜— 1	⅜— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	..	¾— 1¼	¾— 1¼	1⅛	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	72 — 77	72 — 77	75	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	..	10⅜— 11⅛	10⅜— 11⅛	11	10½
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 95	92 — 95	..	..
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	98 —101	98 —101	101	100½
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	86 — 89	86 — 89	..	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2⅝%	49 — 52	49 — 52	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	5 %	..	1½— 2	1⅝— 2	1⅞	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	96 — 99	96 — 99	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	¼— 1⅛	¼— 1⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅜— 3	2⅜— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼— 9⅝	8⅞— 9⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	95 — 98	90 — 100	..	..
85,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	12 — 13	12 — 13	12	..
85,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛xd	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	106 —110	107 —111	110	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18⅛— 19⅛	18⅛— 19⅛	18⅝	18⅛
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	10 1/2	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	4 3/16— 4 5/16	4 3/16— 4 5/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9¼— 10¼	9¼— 10¼	..	..
37,350	Telegraph Construction and Maintenance.	12	20 %	20 %	20 %	34 — 37	33 — 36 xd	35	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	88 — 91	88 — 91	88½	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations March 9th.	Closing Quotations March 16th.	Business done week ended March 16, 1904. Highest	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	⅝ — ¾	⅝ — ¾	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛ — 1⅜	1⅛ — 1⅜ xd	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	115 —118	115 118	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10 — 10½	10¼— 10⅜	10½	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	9⅜— 10¼	9⅜— 10¼ *	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7⅛— 7⅜	7⅛— 7⅜	7⅛	7⅜
70,000	Do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜— 5	4⅜— 5	..	..
40,000	Do. do. 1903	5	..	..	..	4⅜— 5	4⅜— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —103	101 —103	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	5¼— 6	5⅛— 6⅛	6	5⅜ 5⅝
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10¾— 11⅛	10¾ xd 10⅞ xd	10⅞	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14 xd	13	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	104	103
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7⅞— 8⅛	7⅞— 8⅛	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 — 12	11 — 12	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅜— 6½	5⅜— 6½	..	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅞— 6¼	5⅞— 6¼	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	103 —106	103 —106	105	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	10 %	10 %	12%	10½— 11½	11 — 12	11⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1¼— 1⅜	1¼— 1⅜	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4¼— 5⅛	4¼— 5	4⅞	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	96⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¾%	7½%	8½%	17½— 18½	18 — 19	18⅞ 18 1/16	18⅞ 18 1/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
50,000	Do. do. 4 % First Mort. Debs.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	14⅝	14½
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3 — 3½	3 — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1½%	3 %	3⅛— 3⅜	3 — 3⅛ xd	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜— 5	4⅜— 5	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4¼— 5⅛	4¼— 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12½— 13⅝	12½— 13⅝	13⅛	12⅝
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	..	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, March 16th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	82/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	" "	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	" (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£24	..
a	" White Sugar	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	" Caustic (75/80%).. ..	per ton	£24	..
a	" Bisulphate	per ton	£35	..
a	Shellac	per cwt.	205/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	Crystals	per ton	£3	..
a	Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	" Wire, in ton lots ..	per ton	£168	..
b	" Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£48 to £130	..
c	Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
c	" Tube (brazed)	per lb.	8¾d.	..
c	" " (solid drawn).. ..	per lb.	7¼d.	..
c	" Wire, basis..	per lb.	7d.	..
c	Copper Tubes (brazed)	per lb.	9½d.	..
c	" " (solid drawn) ..	per lb.	9¼d.	..
g	Copper Bars (best selected ..	per ton	£70	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£70	..
g	" Rod	per ton	£70	..
e	" (Electrolytic) Bars ..	per ton	£62	..
e	" " Sheets ..	per ton	£78	..
e	" " Rod ..	per ton	£74	..
e	" " H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	3/3	..
f	" Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/7 to 4/8	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	42/6	..
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 5	..
g	" " Sheet	per ton	£13	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 5	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	" " " medium	per lb.	2/6 to 8/9	..
d	" " " large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	" rolled bars & rods	per lb.	1/- to 1/3	..
p	" " strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	" " in bars		£15 to £40	..
g	Tin, Block	per ton	£128 to £129	30/- inc.
g	" Foil	per lb.	1/6	..
n	" Wire, Nos. 1 to 16	per lb.	1/7	..
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	" 6 lea. Flax	per lb.	5¾d.	..
j	" 8 ply 10 lbs. Russian ..	per lb.	4 1/3d.	..
j	" 10 lbs. Russian, single ..	per lb.	4½d.	..
j	" 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
British Elec. Trac. Co.	Aberdeen	Mar. 12	1,085	+226	41	49,496	+ 9,795	10	—
	Birmingham ..	" 12	4,994	+169	11	55,785	+ 2,879	8½	—
	Bournemouth ..	" 9	965	55	49	49,351	—	10½	—
	Blackburn	" 11	702	— 2	—	41,664	+ 2,120	13½	—
	Blackpool	" 10	277	— 46	49	40,769	— 343	8½	—
	" —Fleetw'd	" 12	213	— 22	11	1,913	— 105	7½	—
	" —Lytham	" 10	155	—	19	2,792	+ 2,213	7½	—
	Bolton	" 13	1,705	+ 86	50	89,984	+ 8,928	25	—
	Bradford	" 13	3,491	— 45	48	185,200	+22,787	78	+1
	Brighton	" 13	762	— 54	—	44,145	—	7½	—
	Bristol	" 11	4,343	+ 19	—	—	—	28	—
	Devonport ..	" 4	425	+ 30	9	4,082	+ 659	5	—
	Dudley—Sto'rb'ge	" 4	685	— 13	9	6,533	+ 359	18½	—
	Gateshead ..	" 4	807	— 12	9	7,771	+ 440	10½	+ ½
	Gr'n'k—Pt. Glsgw	" 4	478	+ 40	9	4,282	+ 633	7½	—
	Hartlepool ..	" 4	224	— 4	9	2,201	+ 267	6½	+2
	Middleton.. ..	" 4	228	— 2	9	2,163	+ 184	8½	—
	Oldham—Ashton	" 4	458	— 60	9	4,385	— 232	8	—
	Potteries	" 4	1,589	+126	9	14,572	+ 1,118	28½	—
	Southport	" 4	216	+ 11	9	2,128	+ 226	5½	—
	South Staffs. ..	" 4	667	— 88	9	6,521	+ 855	21½	—½
	Swansea	" 4	417	— 23	9	4,126	+ 183	5½	—
	Wolverhampton..	" 4	303	— 38	9	2,933	— 105	10½	+8
	Yorks. Wool Dist.	" 4	460	+328	9	4,462	+ 1,136	6	—
	Miscellaneous ..	" 4	1,687	—	9	14,108	—	—	—
	Burnley	" 12	573	+163	—	—	—	10½	+8½
	Burton-on-Trent ..	" 13	281	—	32	10,834	—	8½	—
	Cardiff	" 5	1,696	+ 91	—	96,096	+28,052	1	—
	Chatham & District	" 10	490	+ 55	10	4,941	+ 961	9·58	—

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
	Cork	Mar. 10	348	— 57	10	3,819	— 78	9	—
	Dover	" 12	165	— 24	10	1,696	— 128	3	—
	Dublin	" 11	4,100	—209	11	43,357	+ 756	47	+ ½
	East Ham	" 12	609	+ 81	—	32,631	+ 2,736	5	+ ½
	Glasgow	" 12	12,989	+ 3	41	556,842	+54,181	69½	+5½
	Halifax (2 weeks) ..	" 9	2,096	— 69	49	64,392	+ 6,206	33	+2½
	Huddersfield ..	" 5	1,079	+ 34	—	—	—	—	—
	Hull	" 12	1,969	+224	50	95,507	+ 7,773	18	+2
	Ilkeston	" 9	117	—	—	—	—	3½	—
	Ipswich	" 12	308	—	—	4,754	—	9	—
	Isle of Thanet ..	" 12	254	— 82	10	2,175	— 278	10½	—
	Leeds	" 5	4,628	—108	—	264,446	+15,408	41	—
	Liverpool	" 5	9,004	— 74	10	94,322	+ 3,045	108	—
	London C. C. ..	" 12	10,180	+1525	49½	487,719	+34,720	39⅞	—
	Manchester	" 12	10,631	+1992	—	573,236	+287,863	72	—
	Newcastle	" 12	3,526	+484	—	—	—	17	—
	Portsmouth	" 12	1,431	+ 29	—	84,722	+ 5,247	14½	—
	Salford	" 7	3,455	+449	—	185,807	+30,793	30	—
	Sheffield	" 13	4,447	+349	50½	226,983	+18,021	32½	+4½
	Southampton ..	" 10	803	— 45	—	—	—	25⅝	—
	Southend-on-Sea ..	" 9	204	+ 8	49	15,002	+ 2,250	6	—
	Sunderland	" 6	1,017	+ 46	49	58,563	+ 2,794	20	+3
	Tyneside	" 9	276	+ 6	10	2,705	+ 484	8·9	+ ·43
	Wolverhampton ..	" 6	354	— 57	—	—	—	5½	—
	Cen. London Rly...	" 12	7,119	+ 7	11	77,484	+ 757	6	—
	City & S. Lon. Rly.	" 13	3,101	+ 11	11	35,277	— 528	6½	—
	Dublin—Lucan Rly.	" 13	104	+ 9	11	961	+ 65	6½	—
	L'pool Overh'd Rly.	" 13	1,585	+ 21	11	16,678	+ 332	6½	—
	Mersey Railway ..	" 12	1,474	+400	10	14,277	+ 3,557	4½	—

* Compared with the corresponding period of 1903.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE RATED SPEED OF ELECTRIC MOTORS AS AFFECTING THE TYPE TO BE EMPLOYED.

By H. M. Hobart, Member.

(*Abstract of paper read March 10th*, 1904.)

High speed is an unfavourable condition for the continuous current motor, but, up to certain limits, conduces to improved results for induction motors. Of course, the required speed can rarely be the determining factor in the choice between these two classes of motors, but it is well that the extent of the influence of the speed should be realised.

Now it is most difficult to make consistent assumptions as the basis for a number of comparative designs, but I have taken for a set of continuous current designs, for a 150-H.P. shunt motor, five speeds ranging from 68 r.p.m. to 1,224 r.p.m., and, without figuring out the details with any elaboration, have, nevertheless, endeavoured to proceed on fairly reasonable lines. I have followed this same policy with two groups of induction motors, the first group being for 21-cycle motors ranging from 36 poles and 68 r.p.m. to 4 poles and 612 r.p.m., and the second group being for 63-cycle motors, and ranging from 12 poles and 612 r.p.m. to 6 poles and 1,224 r.p.m. Although I should have preferred to concentrate attention upon the influence of the speed, and not to enter upon the question of the influence of the periodicity, the extreme range of speeds which I wished to cover made this impracticable. Thirty-six poles is already abnormal enough for a 150-H.P. induction motor, and yet this leads to a group of three motors, the last of which, at 630 r.p.m., has but four poles, thus requiring stepping up to a higher periodicity for a higher speed design.

In fig. 1 are shown curves roughly indicative of the relative factory costs of these 11 designs for the three groups. These costs have been derived from the product of diameter D, of rotor in centimetres and length L, over armature winding in centimetres—*i.e.*, from D × L for the continuous-current machines. The windings of induction motors being less definite as to overall length, L has been taken equal to the gross core length, λ_g, plus seven-tenths of the air-gap pitch τ, *i.e.*, $L = \lambda_g + 0{\cdot}7\ \tau$ for the induction motors. D × L has been found to be fairly proportional to the total factory cost for continuous current dynamo-electric machines, for a given voltage and for so-called "barrel-wound" armatures. The same expression has also been found fairly proportional to the total factory cost for induction motors.

The total factory cost may thus be set equal to $K_c \times D \times L$ for continuous current motors and to $K_i \times D \times L$ for induction motors where K_c and K_i are constants for any one firm. The ratio of K_c to K_i, which we may denote by R $\left(R = \frac{K_c}{K_i}\right)$ has been found to vary greatly with different manufacturers. From a study of the data kindly supplied to me for the purpose by four manufacturers, it is believed that 1·5 is a fair value to take for R for the purposes for which it is required in this paper. Thus, for motors having equal rotor dimensions, the continuous current motor will be taken as costing 50 per cent. more than the induction motor. This, however, would not be the ratio of cost for the same *output*, because different diameters and lengths would be taken in the two cases. As a rough value for the total factory cost of continuous current motors, 1·00 shilling per D×L may be taken (although this varies considerably with different manufacturers), D and L being expressed in centimetres. Hence 0·67 shilling per D × L will be the corresponding total factory cost for induction motors. This would rise to 0·75 shilling per D × L for motors with wound rotors, and would fall to 0·60 shilling per D × L for motors with squirrel cage rotors.* At low speeds the diameter would be much greater in the case of induction motors. At high speeds, and especially at low periodicities, the reverse would be the case. This is shown in fig. 2. In the upper part of fig. 3 are given the full-load efficiencies for the continuous current and the induction motors. Whereas the former are lower for the higher speeds, the efficiencies of the induction motors rise fairly rapidly, starting from a very low value for the lowest speeds. In the lower part of fig. 3 are given corresponding curves of half-load efficiencies.

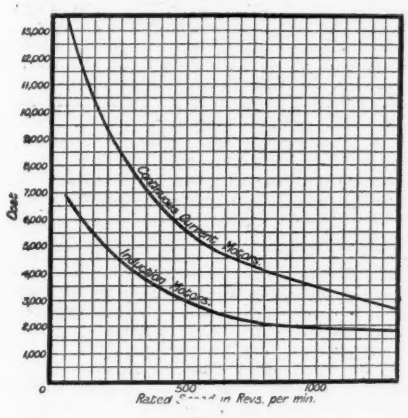


Fig. 1.

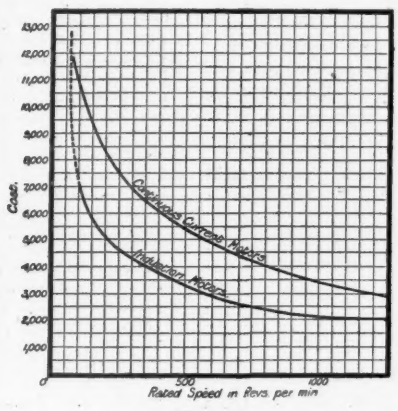


Fig. 1a.

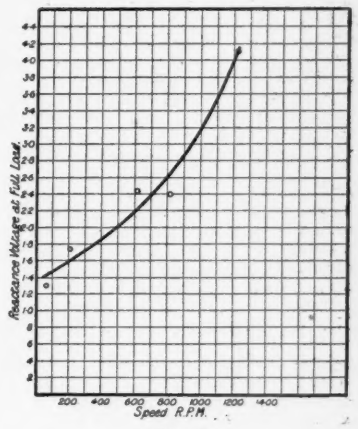


Fig. 5.

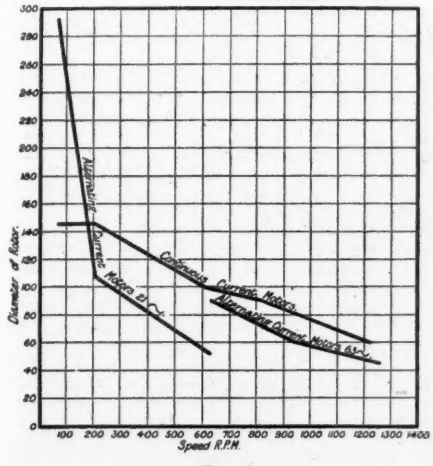


Fig. 2.

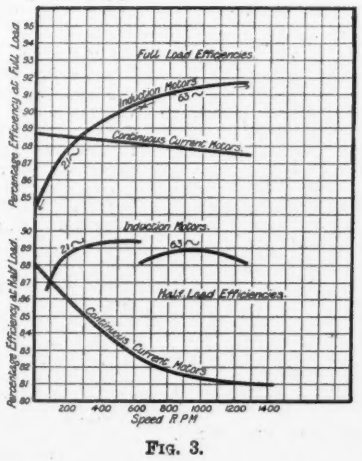


Fig. 3.

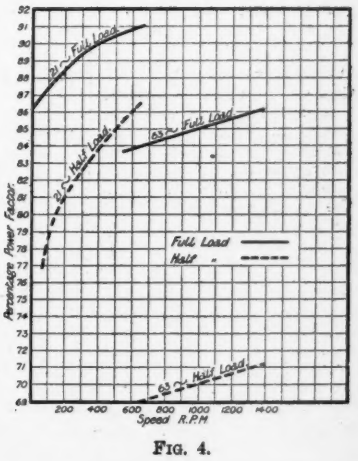


Fig. 4.

From fig. 4 it may be seen how the power factor improves with the speed; the no-load current at the same time decreases.

Fig. 5 shows the increase in reactance voltage at full load, for increasing rated speed. As is evident, the results are very unfavourable for the higher speeds, whereas they are decidedly favourable for the lower speeds. Where special methods of commutation are not resorted to, high commutator speeds must be employed for high-speed designs of continuous-current dynamos.

It is thus evident that with increasing speed, while all the properties of the induction motor improve markedly, the reverse is the case for the continuous-current motor, and one would be inclined to believe that this points out the best field for these respective types, and that the influence of the speed should be taken into consideration when other circumstances permit.

* This paper does not concern itself with *absolute* costs. The comparisons are purely relative. Nevertheless, it serves to fix ideas to employ some unit of value, and the equivalent chosen has been shown to apply approximately in an article published in No. 40 of the *E.T.Z.* for 1903.

Where continuous-current and induction motors come up for comparison, it is natural that one should seek for some common ground as a basis for the designs. It has seemed to me that the most significant common attribute for this purpose, is the ratio $\frac{\lambda}{\tau}$, in which λ equals the length of laminations between end flanges (λ_g = gross core length and λ_n = net core length) and τ = polar pitch at the air-gap, *i.e.*, the circumference at the air-gap divided by the number of poles. As already described, the cost of the induction motors has been taken proportional to $D \times (\lambda_g + 0{\cdot}7\,\tau)$, and the cost of the continuous-current motors to $D \times L$ where L = length over end connections. In general for continuous-current motors, L is also approximately equal to $\lambda_g + 0{\cdot}7\,\tau$, although in the case of well-defined windings having the end connections lying in extensions of the armature core's external cylindrical surface, it is more instructive to use the expression $D \times L$ as the basis for cost estimates and comparisons.

λ/τ is again useful in obtaining the value of C in Behrend's formula for the leakage factor σ which is $\sigma = C \cdot \Delta/\tau$, Δ being the radial depth of the air-gap.

The writer obtains the values for C from curves showing it as a function of the ratio λ/τ, and finds that this leads to results rather more accurate than are otherwise obtainable from Behrend's formula, and far more conveniently arrived at than by means of the more complex formulæ sometimes employed for the estimation of σ.

In the case of the induction motors the radial depth of the air-gap has been taken at 0·18 cms. for all cases.

For a moderate range of speeds, for the same output, say a range of 1 to 4, I should have taken the same number of poles and the same diameter for all my continuous-current designs, as I find this to be a practicable and correct designing principle for this class of machinery. Here, however, with a speed range of 1 to 18, the lower speed designs are given more poles and larger diameter, and *vice versâ* for the higher speed designs.

[Details of these eleven designs were given in the paper.]

It is interesting to derive the costs by another and independent method which consists in determining the cost of the effective material on the one hand, and of the non-effective material independently on the other. The latter component can be derived if a sufficient number of machines of the same diameter, but of variable length, are plotted with the cost of the non-effective material as ordinates, and the effective length L as abscissæ. By these means a curve can be obtained which, if produced, intersects the axis of ordinates at a point giving the cost of non-effective material for zero effective length of armature.

This has been investigated by the author as described in *E.T.Z.*, No. 40, 1903, and it has been found that the cost of the non-effective material for zero net length of armature core equals approximately $D_1^2/10$ shillings, if D denotes the external diameter of the yoke in cm. Such a curve also shows the increase in the cost of the non-effective material in dependency upon the net length of the armature core, and taking into account the influence of the diameter, one could roughly set this increase as equal to $0{\cdot}18\ D_1\ \lambda_n$.

The estimation of the costs by this method is carried out in Table III. for the continuous current motors.

TABLE III.—Estimation of Total Works Cost of 150-H.P. Continuous Current Motors.

Diameter over all (D_1) ...	225	212	165	154·6	124
Cost of non-effective material for zero length of armature core	5,100	4,500	2,700	2,400	1,550
Increase in cost of non-effective material with increased length	1,460	480	300	235	260
Cost of effective material ...	5,360	2,610	1,535	1,395	1,075
Total works cost	11,920	7,590	4,535	4,080	2,885
Do. by D × L rule ...	12,900	8,060	4,880	4,080	2,820

The same method has been applied as shown in Table IV. to the induction motors, $D_1^2/15$ shillings being taken as the cost of non-effective material for zero net length of armature core, and $0{\cdot}12\ D_1\ \lambda_n$ being the increase in cost of non-effective material with increased length. It will be seen that a good agreement is obtained in all except the first case.

TABLE IV.—Estimation of Total Works Cost of 150-H.P. Induction Motors.

Diameter over all (D_1)	364	164	116	146	116	102
Cost of non-effective material for zero length of armature core	8,900	1,800	890	1,420	900	700
Increase in cost of non-effective material with increased length	660	790	560	300	350	440
Cost of effective material	2,840	2,320	1,440	940	850	860
Total works cost ...	12 400*	4,910	2 890	2,660	2,100	2,000
Do. by D × L rule	6,700*	4,850	2,610	2,200	1,870	1,820

* This is an abnormal machine in every respect, but nevertheless closely follows lines of machines at present in operation. The D × L rule in so extreme a case gives far too low a value, and the value obtained by the analytical method is a trifle too high.

The costs as obtained in Tables III. and IV. are plotted in the curves of fig. 1A, and it will be seen that the results lead to much the same conclusions as were arrived at by the E × L method and plotted in fig. 1.

The principal conclusions arrived at in this paper are as follows:—

1. Induction motors are, for all capacities, considerably cheaper than continuous-current motors of equivalent ratings.
2. The general performance and the mechanical construction of induction motors improve rapidly with increasing rated speeds.
3. The general performance and the mechanical construction of continuous-current motors improve rapidly with decreasing rated speeds.
4. The use of very low-speed induction motors and very high-speed continuous-current motors ought to be avoided whenever this is commercially practicable.

These conclusions are not new. They must, however, be much more widely understood if the electric transmission of power is to proceed on rational lines.

Discussion.

The discussion was opened by Prof. S. P. Thompson, who commented on the fact that the relative merits of D.C. and induction motors are clearly defined. He illustrated the influence of the many variable quantities on the design and of surface speed on the cost and operation of motors.

Dr. Drysdale considered that a range of sizes from 5 to 30 H.P. would have proved more valuable than those taken in the paper. In regard to the factory cost value, he thought that the Steinmetz core dimension would have been preferable to D × L, as given by the author. He had found, with small machines at the Northampton Institute, that the cost per sq. cm. was 2s. 6d. very generally. As the speed of the motor so largely depends on the mechanical engineer, he suggested that high-speed motors and reduction gear, which could now be obtained with an efficiency of 90 to 95 per cent., should be developed in preference to the low-speed motors.

Mr. Meyer did not think the facts brought forward in the paper were consistent with practice. Too wide a range of speed was covered, and the cost formula was not very reliable. He considered that the size of motor taken was exceptional, and that abnormal designs should be treated as specials. He was unable to agree with the results given by the author.

Mr. G. Stoney stated that Messrs. Parsons had been able to obtain fixed commutation through a wide range of load and including heavy overloads, by means of compensating windings; their high speed generators had a few large poles, and compensation was provided for heavy armature reaction. They obtained excellent voltage regulation, only 2 per cent. drop full load to no load.

Mr. H. M. Hobart, in reply, stated that frequently the low peripheral speed machine comes out cheaper in total cost. High speed machines added to the labour item. With the remarks on high speed alternators he quite agreed.

THE DISTRIBUTION OF ELECTRICITY IN SHIPYARDS AND ENGINE WORKS.

A paper on the above subject was read before the Newcastle Section on January 18th by J. A. Anderson. The author was of opinion that for lighting and power work a mixed system was best, viz., three-phase alternating for power and three-wire continuous current for lighting, the continuous current being obtained from motor-generators. This permits of large momentary fluctuations on the power circuits without the lighting being affected. The following is an abstract of the principal points in the paper.

Three-phase motors cost less for maintenance than continuous current motors, and will stand overloading to a much greater extent and for a longer time. A smaller motor may therefore often be employed.

For most purposes squirrel-case motors are preferable to those with wound rotors. They are a little more efficient and the connections are not so complicated.

The chief trouble is in starting up. For full load torque, the squirrel-cage motor takes about 2½ times full load current, whereas a slip ring motor will exert full load torque with full load current.

This, of course, means that squirrel-cage machines must have very heavy fuses in circuit.

For winches and cranes, the slip-ring motor is preferable. The author has used a change-over switch for starting squirrel-cage motors, so arranged that heavier fuses are in circuit for starting than for running.

Touching on the question of comparative costs of running, the author gives figures of gas consumption and electrical energy for a shipyard shed. This was formerly driven by means of a 50-N.H.P. gas engine through shafting and belting. Most of the shafting has been dispensed with, and squirrel-cage motors installed.

There are now 11 motors of the following powers:—

Six punching and shearing machines, 7½ H.P. each	= 45 H.P.
One 27 ft. × 1½ in. plate rolls	= 30 „
Two scarfing machines and plate-edge planers, 10 H.P.	= 20 „
One 6 ft. 6 in. × 1 in. plate straightening roll, two countersinks, and one grindstone	= 10 „
Two countersinking machines	= 5 „
Total	110 H.P.

Five months' gas consumption for the engine driving the above machines was 1,380,500 cb. ft., which at 2s. 6d. per 1,000, less 20 per cent. discount, amounts to £138 1s.

Attendance, water, oil and stores accounted for £57 11s., making a total for the five months of £195 12s. This does not include interest, depreciation, or repairs. For a similar period the consumption of electrical energy was 32,916 units, which at 1 1/16d., amounts to £145 14s.

No attendance was required, and the costs of maintenance and other charges are more than counterbalanced by the saving in upkeep of belts and shafting and repairs to the engine. There is thus a saving of about £50 by electric driving.

The author prefers belts to gearing for driving shipyard tools, as this method is easier on the motor. For driving plate rolls, open and crossed belts are found to be more satisfactory than a reversing motor. Driving cranes by three-phase motors is not so simple as with continuous current. If three motors are used they must be of the slip-ring type, and this necessitates the use of 12 wires between the crane girders. The following data are taken from actual observations:—

5-h.p. Squirrel-Cage Motor, 800 Revolutions, driving two Countersinking Machines by Belt and Countershaft.

Work done.	kw.	Remarks.
Shaft and countersinks running light	2·7	—
One head countersinking ¾-in. holes in ⅝-in. plate	2·8	Minimum.
" " " " "	4·8	Maximum.
Two heads " " " "	2·8	Minimum.
" " " " "	7·4	Maximum.

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving Punch and Shear by Belt on Fly-wheel. 27 Punches per Minute.

Work done.	kw.	Remarks.
Running machine light	3·1	—
Punching ¾-in. holes in ⅝-in. plate...	3 8	Minimum.
" " "	5·4	Maximum.
Shearing ½-in. plate	7·4	—
" "	8·8	Average.
" "	9·4	—
" ⅝-in. plate 21 ft. long	5·4	—
" " "	8	Average.
" " "	11	Operation took 1 min. 20 sec.
" ⅝-in. plate 21 ft. long, cut about 3 in. wide	5 6	—
" " " " "	9	Operation took 1 min. 10 sec.

In shearing, the load varies with the width of cut as well as the thickness. Some figures taken from another machine, shearing 1 in. plate, 2 in. to 3 in. width of cut, show a 7½-h.p. motor taking from 6 kw. to 12 kw.

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving Mast Rolls by Countershafting and Open and Crossed Belts.

Work done.	kw.
Countershafting and loose pulleys	2·8
Rolls running light	3·3
Rolling 4/20 in. plate to half circle	4 to
" " "	7

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving a Double-Headed Boiler-Shell Drilling Machine by Belt and Countershaft.

Work done	kw.	Remarks.
Drills running light	2·6	—
Drilling one 1 3/16 in. hole in boiler shell	3·5	—
" " " "	3·8	—
Drilling two 1 3/16 in. holes in boiler shell	4·5	—
" " " "	5	—
Drilling one 1⅝ in hole in 1½ in. plate	4·5	Sharp drill
" " " "	4·7	Op'n took 1 m. 40sec.
Drilling one 1⅞ in. hole in 1 7/16 in. plate	4·6	Blunt drill
" " "	5	Op'n took 2 m. 5 sec.
Drilling two 1⅝ in. holes in 1½ in. plate	6·7	Sharp drill
" " " "	7·7	

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving Brick Crusher.

Work done.	kw.
Crusher running light	2·8
Crushing bri ks	3
" "	6
" "	8

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving a Buck and Hickman Mortar Mill with a Revolving Pan, 7 ft. Diameter, 16 Revolutions per Minute, by Countershaft and Loose Pulley.

Work done.	kw.
Countershaft and loose pulley	2·4
Runni ng mill with pan empty	4·4
Mixing with pan full	7·6
" " 5 minutes after	6·8
" " 15 "	6·4
" " 24 "	6·4

7½-h.p. Squirrel-Cage Motor, 800 Revolutions, driving "Koppel" Concrete Mixer by Countershaft and Loose Pulley.

Work done.	kw.
Running on loose pulley...	2 1
Machine running empty	2·6
Hoisting tub filled with ballast and cement	5·2
Mixing with cylinder charged	3·8
" "	4·0
" "	4·4

10-h.p. Squirrel-Cage Motor, 800 Revolutions, driving Two-Headed Scarfing Machine and a Plate-Edge Planing Machine by Belt driving a Countershaft with Loose Pulleys, Crossed and Open Belts.

Work done.	kw.	Remarks.
Countershaft and loose pulleys	4 7	—
One-head scarfing cut ⅜ in. to ½ in. by 9 in. long	5·2	Minimum.
" " "	7 8	Maximum.
Planing ⅝ in. plate 20 ft. long	9 2	—
" " "	13	Average.
" " "	16	—
Planing 17/32 in. plate 20 ft. long and scarfing 17/32 in. plate	10	—
Planing 17/32 in. plate 20 ft. long and scarfing 17/32 in. plate	13	—
Planing 17/32 in. plate 20 ft. long and scarfing 17/32 in. plate	16	—
Planing 17/32 in. plate 20 ft. long and scarfing 17/32 in. plate	18	Maximum for five seconds.

10-h.p. Slip-Ring Motor, 800 Revolutions, driving Angle-Iron Planer by Worm, Worm-Wheel and Gearing. Speed controlled and rotation reversed by controller.

Work done.	kw.
Planing 10-in. channel iron cut ⅝ in. × 1/16 in.	3·8
" " "	4·8
" " "	5·8
" " "	6·6
Planing 4-in. angle-iron cut 7/16 × 1/16 to ⅛ in.	6
" " "	6·8
" " "	7
" " "	8

10-h.p. Squirrel-Cage Motor, 800 Revolutions, driving Quadruple Punching and Shearing Machine by Belt, Motor Underground.

Work done.	kw.
Shearing ¾-in. steel plate	14
" "	16
Punching 4-in. holes in ¾-in. steel plate	16
" " "	18
" " "	20 8*

* Motor slowed up.

This machine had very light fly-wheels, and the steel plates were for some special purpose not often required in ordinary shipyard use. The plate was fed in as fast as possible for the purpose of taking the test.

10-h.p. Squirrel-Cage Motor, 800 Revolutions, driving 6-cwt. Pilkington Hammer and a Fan for Two Smiths' Fires.

Work done.	kw.
Shafting, fan, and loose pulley on hammer	3 6
Hammer cushioning	8
Hammer working	11
" "	13

15-h.p. Squirrel-Cage Motor, 800 Revolutions, driving a Manhole Punch by Gearing.

Work done.	kw.
Machine running light	3·2
Punching 24 in. × 18 in. manholes in 7/20-in. plate	19 6
" " " "	21 2
" " " "	22 4

30-h.p. Squirrel-Cage Motor, 480 Revolutions, driving 27 ft. × 1⅛ in. Plate Rolls by Belt on to Countershaft with Crossed and Open Belts.

Work done.	kw.	Remarks.
Rolls running light	11·4	—
Lifting top roll	14·4	—
Lowering top roll...	11·6	—
Rolling ½-in. plate	12·8	—
" "	14·4	—
" "	40·0	Momentary.
Straightening ⅝-in. plate...	13·4	—

30-h.p. Slip-Ring Motor, driving Joggling Machine by Gearing, with the Speed varied and Rotation reversed by a Controller with Heavy Resistances in the Rotor Circuit.

Work done.	kw.
Joggler running light	4
Joggling ½-in. plate at 5 ft. 9 in. per minute	5·2
" " " "	5·6
" 1 3/20 in. " "	7·6
" " " "	8·4
" " " "	10
" 1 4/20 in. " "	11
" " " "	12
" " " "	14

ELECTRICAL PLANT FAILURES.

A paper was read before the Institution of Mining Engineers last July by Mr. A. Campbell Cormack, a copy of which was recently sent to us. As we are told in the beginning, the title of the paper is misleading, inasmuch as electrical plant failures in general are not dealt with, but merely those relating to dynamos and motors,

which have been compiled from the statistics of the National Boiler and General Insurance Co., Ltd., extending over a period of about four years; but unfortunately no indication is given as to whether the machines—or what proportion of them—were working at collieries, or under what conditions the breakdowns occurred, which would have made the paper much more interesting to the mining engineers for whose benefit it was read. No coal-cutting machines are included "as statistics from these are far from complete," but the probabilities are that very few coal-cutting machines have been insured with the above-named company, and hence the author will have had few opportunities of observing these machines.

In dealing with the subject three tables have been prepared, which are given at the end of the paper, viz.:—Table A., showing the relative frequency with which various portions of dynamos and electric motors were damaged when breakdowns occurred; table B., showing points of origin of breakdowns, and Table C., showing the causes to which the derangements were due; and the paper consists in generally describing with slightly more detail the defects enumerated in the tables. Here the author would appear to have missed a splendid opportunity—especially in Table B.—of placing before the members of the Institution points in the construction and design of machines which are to be avoided, and in Table C. hints on working and attention could have been given, which we feel sure would have been appreciated.

To the mining engineer it is of little use to know that 47·80 per cent. of the breakdowns originated in armatures, without its being in any way explained, say, by means of a few examples, what caused the failures and how best to prevent them. The real tendency of the paper seems to have been to impress upon the colliery manager the necessity of engaging the services of a consulting electrical engineer to design, install, and look after any electrical plant he may think of adopting, or, perhaps, to employ the National Boiler and General Insurance Co., Ltd., and however advantageous the services of an Insurance Co. or an electrical consulting engineer would be to the colliery manager, the transactions of an engineering Institution are scarcely the place in which to point the fact.

THE COMPARATIVE BEHAVIOUR OF FLOATING AND BOOSTER-CONTROLLED BATTERIES ON FLUCTUATING LOADS.

(*Concluded from page* 440.)

Case III.—Battery with Booster in Power Station.

In this case, the load being constant, the author assumes a station voltage of 550, the load and conditions being as in Case I.

Average load, 600 amperes; maximum load, 1,000 amperes; a battery discharge of 400 amperes is required. If the one-hour rate is not exceeded, an 800-ampere-hour battery is required; however, with maximum loads of only 5 seconds duration, a 700-ampere-hour battery, having a one-hour rate of 350 amperes, will suffice, momentary overloads being 17 per cent.

In this case the feeder point E.M.Fs. at varying loads will not be so satisfactory as with a compound-wound generator, and the author calculates from the line resistance that 805,000 circular mils copper would be required, as against 665,000, the generating plant, however, being reduced from 550 KW. to 350 KW. and the working efficiency greatly improved.

Compared with a shunt-wound generator, with floating battery at the power station, the comparison is 350-KW. plant against 440 KW.; copper 805,000 circ. mils as against 945 000; load variations, 6 per cent. as against 47 per cent.; volts variation at feeding points, 19 per cent. against 20 per cent., the factors being equalised owing to greater amount of copper in the line fed by the floating battery.

Case IV.—Battery and Booster out on Line.

In this case a constant current will pass over the feeder, the average load only being transmitted from the power station, and taking similar working conditions to previous cases, the author calculates the line copper at 415,000 circ. mils; the voltage, however, at the booster is limited to 350, and if we take 420 as a better figure, the copper becomes 720,000 circ. mils.

Compared with Case II. (floating battery on line) this arrangement is considered more satisfactory. The copper in the ratio 720,000 circ. mils to 495,000 circ. mils (Case II.), is not a real comparison in view of the higher voltage maintained.

The generator load is also constant, within 6 per cent., as against 17 per cent. While the booster-controlled battery on the line is theoretically superior to a similar power station equipment, the former requires extra attendance, which may neutralise its advantages, and in practice it is better to put the booster and battery at the power station, adding copper to the line, or to install a floating battery at the feeding pit.

Owing, however, to the fact that numerous feeders are generally employed, it is not practicable to install a battery on any one feeder, and therefore regulation of the station load is better effected by means of a battery plant at the station.

The booster-controlled battery possesses the important advantage over the floating type of being able to give full battery discharge, even when nearly exhausted; another advantage is cited in the absence of troublesome manipulations in case of overcharge.

Case V.—Booster in Station; Battery on Line.

This arrangement is peculiar in that only one type of booster may be used, and there must be a separate feeder from the booster to the point where the battery is located. If the circuits in the cases discussed were merely a simple trolley and track with distributed loads, any of the four described applications could be used.

The discussion, summarised, was to the effect that storage batteries promote efficient working, and are especially useful with the D.C. distributing plants in connection with alternating transmission plant.

J. W. Lieb, New York, considered that the most important feature of such a generating equipment is constancy of field excitation, and the storage battery secures that result. It has been found essential to the equipment of a large power plant, whether the excitation be from steam-driven exciters or motor-generator exciter sets, to have in addition a storage battery to be floated on the system in parallel with the exciter sets. The effect of any disturbance of the exciter current on enormous capacities, operating in parallel, would be exceedingly grave. The current supply from either steam generating sets or motor-generator sets may be subject to interruption, and the question arises in such a condition, whether it is wiser to use a battery which shall have in series with it a booster, such as is outlined in the paper, or whether to depend upon the battery, without any assisting elements. Any failure of the exciting current would require that the element to replace it should be instantaneously available. The battery should have in series with it a booster of some type of winding which, when the other source of current supply failed, would instantly go into action and supply a continual voltage to the discharge voltage of the battery, so that no falling of the exciter voltage would take place. It was found, however, that if the battery was of reasonable capacity, as compared with the exciter sets, a very limited voltage drop occurred, and there seemed to be in the system a larger flexibility than the conditions of discharge voltage and drop in the battery would indicate. That led to the desirability of a battery which would have larger discharge capacities at the higher rates. The effects which result from disturbances in a very large transmission system are so serious and so violent that in order to secure absolutely constant supply, it is necessary to have very large storage-battery capacity at the distributing points to meet any emergencies, and with several direct-current distributing plants operating in parallel, it becomes necessary to have capacities from 15 to 30 per cent. of the generating capacity out on the line.

ROYAL COMMISSION ON LONDON TRAFFIC.

At the sitting of the Royal Commission on Thursday last week, at the Westminster Palace Hotel, under the chairmanship of Sir D. Barbour, evidence was given by Mr. Howard Humphreys, M.I.M.E., consulting engineer to the National Traction Engine Owners and Users' Association, who pointed out that the use of traction engines and heavy self-propelled vehicles was rapidly increasing in London, Liverpool, Manchester and other towns, owing to the great advantages they possessed in the haulage of the large types of power and manufacturing plant now in demand, &c. He complained that the limitation of the speed of such vehicles to 2 miles an hour in towns was useless, and caused obstruction to the other traffic. He was opposed to the proposed bye-laws of the L.C.C., which would restrict such vehicles to the main roads and close the by-streets *en bloc* to steam haulage.

The Hon. J. Scott Montague, M.P., believed that the best way of remedying the congestion of the traffic in London was to get the traffic to move more quickly, and one of the ways in which this could be brought about was by the gradual increase of mechanical traction, resulting in higher speed, and therefore enabling more traffic to pass through a given street in a given time. He called attention to the danger and inconvenience of the centre standards in the case of electric tramways, and held them responsible for many accidents.

In answer to Lord Ribblesdale, Witness said some years ago he moved in the House of Commons that in the case of the line of the London United Tramways Co., the standards should be placed on the side of the road, and this was done by Mr. Clifton Robinson. He would like to see Parliament insist on the placing of such standards on the side of the roads.

Mr. Charles Booth gave evidence, and said improved internal and external communication was required for London, and in no other way could the insufficiency and dearness of house accommodation be obviated. A complete scheme was called for and combined use must be made of tubes, sub-surface and surface tramways, railways and ordinary roads. He advocated the establishment of a special tribunal by Government, the members of which should be paid. This tribunal should study the whole field in order to lay down general principles of action, to consider the merits of any proposals that might be laid before it and to report to Parliament. It would be the place of the L.C.C., or other local governing body, to supplement or replace the action of private enterprise as might be required, but every scheme, however originating, which needed Parliamentary sanction, would come before the tribunal and be reported on.

On Friday, evidence was given by Major-General Webber, C.B., founder of and a past-president of the Institution of Electrical Engineers. As an officer in the Postal Telegraph Service, formerly chief engineer of the City of London Electric Lighting Co., founder of the first company (the Chelsea) which undertook the distribution of

electricity under statute, and in other capacities he had an intimate acquaintance with the thoroughfares of London. He was early impressed with the need of developing means of north and south communication in the West of London, and more particularly by connecting Clapham Junction with Paddington. Witness submitted a long list of figures collected in 1893, showing the traffic north and south, on which the estimates for a proposed line at that date were based. He felt little doubt that if the line had been built it would now be carrying at least 15,000,000 passengers annually. The well-known uniform conditions of the stratum which was known as London clay, provided unique facility for the construction of tube railways, which he believed did not exist under any city in the world to the same degree. These conditions along the north and south route for connecting Clapham Junction to Paddington were exceptionally favourable for economical construction. These and other conditions enabled Mr. Greathead to make his estimate for the railway, two tubes of 11 ft. 6 in. internal diameter, permanent way and stations, exclusive of electrical equipment and rolling stock, at £907,000. He mentioned this because the cost of the tube lines, with their stations, which passed under the most densely-occupied parts of London, which had been lately constructed, had been much more in proportion. As he had been carefully into the estimates, he attributed these excessive costs not only to the fact that the stations represented a very excessive item, both as stations and as points of access to the surface during construction, but also to the heavy watering of capital, which had only been possible through the ignorance of the investors as to what these lines should honestly cost, which had led to the financiers finding it necessary to load the engineers' estimates with big amounts for contingencies, which had nothing to do with the true cost of these tube lines. The use of tube lines, so eminently adapted to the sub-soil of London, had been, and was, seriously limited through those exaggerated costs. He was certain that, when Sir J. Kennaway's Committee, in 1893, threw out the Bill for the proposed Clapham Junction and Paddington Railway, they were instrumental in preventing the execution of a project which Mr. Greathead and himself were pledged to those who were to find the capital to carry out at a fair cost price. If this had been done, it would have been a standard of cost for other lines, and have justified extensions which, at the present prohibitive costs, were impossible. Again, the scheme for the locomotive part of the work would have been adapted not only to the very varying traffic loads, but also to the public convenience, of having single and multiple cars passing the eight intermediate stations between the termini at one-minute intervals. The electrical block designed to permit of this, and absolutely to prevent one car or pair of cars overtaking one another, presented no difficulties, and was eminently adapted to the diurnal varying nature of the traffic, as well as to most special emergencies. For subway railways situated as this he had always favoured a system which provided smaller load limits than those of the Underground and latest tube railways, and increased frequency with less distance between the units. In this direction, the electrical engineer, except on surface tramways, had had no chance of showing what he could do, for he had been entirely governed by the rules of the older railway engineers.

Witness was next examined on the question of obstruction to traffic by undertakers having statutory powers to disturb the surface of streets. Referring to telegraph cables he said that the solid system inevitably, after a time, required frequent disturbance of the surface, but the "drawing in and out" system, once laid, with prudent foresight as regarded spare space in the tube, reduced interference with traffic to a minimum. This system cost about one half more than the solid system. With regard to the ideal provision of subways under the streets, one must have worked, as he had, in most of the streets of the City to realise its impossibility, except at enormous cost and vast interference with the several services. In 99 per cent. of the streets of the metropolis such subways would be altogether out of the question.

Mr. Robert Elliott-Cooper, M.I.C.E., said he had designed and carried out, as chief engineer, railways and other engineering works, to the value of many millions sterling. He had closely investigated the problem of providing better means of locomotion in and about London, and that of diminishing the congestion of traffic between the centre and outlying parts of the Metropolis. In the course of such investigation he had been able to form an opinion as to the particular localities in which means of transport and transit were most deficient, and the means by which such deficiency should be remedied. He was well acquainted with the mode of construction and cost of tube railways, and had been engaged since the works commenced in advising upon various points connected with the construction of the two tube railways now far advanced toward completion, viz., the Great Northern, Piccadilly, and Brompton Railway, and the Charing Cross, Euston, and Hampstead Railway. Tubular railways, worked by electricity, and passing beneath the public streets and roads, linking up well recognised centres, seemed to him to be the best means of attaining the end in view, except on some routes south of the Thames, where an overhead railway would be more convenient and cheaper. No doubt shallow subways, with railways running therein, would be very convenient, but under existing conditions the construction of these subways, necessitating as it would the disconnection and reconstruction of gas, water, and sewage pipes, was surrounded with insuperable difficulty except in the case of new wide thoroughfares. The enormous outlay necessitated at the outset for compensation for cellar rights, besides the actual cost of carrying out the work itself, would preclude private enterprise from entertaining such schemes, as the cost would make any adequate return doubtful. As regards tubular railways, he was of opinion that a through route through London would lead to better results than a closed circle. There was one great objection to any closed circle scheme, that it was by the nature of things incapable of further extension except by junctions, which would be practically unworkable, and which were reported against by the original Joint Committee, of which Lord Cross was chairman. The experience of the Metropolitan and Metropolitan District Railways since the circle was joined up was conclusive on this point. The work of completing the circle was carried out at an enormous expense, but with very unsatisfactory results so far as increased traffic was concerned, and it was very clear that a closed circle railway could only move people round and round in a given area instead of moving them in and about, with possibilities of indefinite extension, as was increasingly required in the interests of metropolitan development. The main lines having termini in London could not, under existing conditions, deal with the enormous suburban traffic which pours into and out of the central districts of the City and West End. In the case of the Great Northern Co., the congestion at King's Cross would be greatly relieved by the construction of the Great Northern and City Tube Railway, and the Great Northern, Brompton and Piccadilly Tube Railway. The best solution to this difficulty would be found in the development of electrical suburban communications, and for this purpose it was essential that a through route, running between the North-East and South-West of London, should be created, capable of extension, and joining up with the extensive system of tramways which were now being established throughout the counties immediately surrounding the metropolis, and with the lines of electric railway already authorised. A system of tramways either along the surface of the streets, or in shallow subways, could not efficiently deal with the large traffic between the outside districts and the heart of the City and the busy centres of the West End. If constructed on the surface of the streets, the congestion of traffic would be greatly intensified. Witness then proceeded to explain in detail the scheme brought forward by Mr. Arnold Hills for the Hammersmith, City and North-East London Railway, which route was reported on by the Joint Committee of 1901, and passed by Lord Windsor's Committee in 1902. He said that a service of electrical trains running at intervals of from two to three minutes from the West to the City, and from the North-East to the West End, provided a means of communication which would meet the needs of the great tide of travel which was continually setting north and south and east and west. For such a railway accommodating the large traffic along the Hammersmith Road, Piccadilly, Strand and Cannon Street, he believed there would be no difficulty in raising the requisite money on reasonable terms. The total cost of such a railway of a length of 23¾ miles, including generating stations, was £7,232,947.

THE CONTINENTAL ELECTRICAL INDUSTRY.

German Interest in Steam Turbines.

The Allgemeine Elektricitäts Gesellschaft, of Berlin, is pursuing its policy of amalgamation, absorption or concentration in various directions, and for this purpose the share capital of the company is to be increased from £3,000,000 to £4,300,000. A portion of the additional capital of £1,300,000 is required for the company's share in the steam turbine company which is to develop in Europe the American Curtis type of turbine, and also that devised by Riedler and Stumpf. A second portion is needed to ensure the entire absorption of the Union Electricity Co.; a third portion is for the purchase of one-half of the shares of the Austrian Union Electricity Co.; and a fourth portion (£175,000) represents the sum which in shares is to be exchanged for shares of the nominal value of £225,000 in Brown, Boveri & Co., of Baden, Switzerland. The object of the last arrangement, which will transfer one-half of the capital of the Swiss company into the possession of the Allgemeine Co., is to bring about a general turbine connection, as the Brown-Boveri Co. is the European licensee for the Parsons turbine, which has already been largely introduced on the Continent. In this way the Allgemeine Co. will be directly or indirectly concerned with the leading American, German and English types of turbines, so that competition may perhaps be entirely avoided, and be supplanted by general co-operation between the various interests.

The name of the Siemens-Schuckert Works Co., in emulation of the arrangements which were recently concluded between the General Electric Co., of New York, and the Berlin Allgemeine Co., has now been coupled with that of the American Westinghouse Co. in the sense that these two may form a kind of counter combination. At the moment it is uncertain whether there is any real foundation for the rumour, but it would scarcely be surprising if it should eventually prove to be correct. In the meantime, it may be noted that the Siemens-Schuckert Co., together with the Krupp Steel Co., the North German Engineering Co., the Augsburg Machine Works Co., and the French Schneider Co., of Creusot, has become interested in the Zoelly steam turbine, which is being made by the Swiss firm of Escher, Wyss & Co., for driving dynamos and the propulsion of ships.

The Busch Wagon and Machine Works Co., of Hamburg-Bautzen, which is interested in the English firm of Milnes & Co., of Hadley, to the extent of over £33,000, has closed the financial year 1902-3 with a loss of £7,058 on working, which becomes increased to £12,090 with provision made for depreciation. At the forthcoming meeting the directors will submit a resolution in favour of abstaining from any participation in the reorganisation of the before-mentioned English company.

French and Swiss Companies.

The report of the Telephone Industrial Co. (Société Industrielle des Téléphones) for 1902-3 exhibits gross profits amounting to £97,137, as compared with £92,158 in the previous year, and net profits totalling £52,020, as against £46,942. A dividend at the rate of 12 fr. per share has been declared, being the same rate as in the preceding 12 months. The capital comprises £720,000 in ordinary shares, and £372,000 in bonds. The report states that the Senate has authorised the construction of the long-projected new cables, and the company has secured the contract for that to be laid between Brest and Dakar at an estimated cost of £640,000.

The Paris General Electricity Co., which has a share capital of £600,000, has returned to the path of prosperity after the lapse of a year. Including the balance brought forward, the net profits for 1902-03 amount to £44,865 as compared with £34,894 in the preceding year when a large portion of the latter sum was devoted to the purpose of depreciation, and no dividend was paid. The distribution of 12s. per share for the past year compares with the £1 per share which was paid two years ago, while the balance has been partly placed to the contingency fund, and partly carried forward to the next account.

The Oerlikon Engineering Works Co, which has a share capital of £240,000, and a bond issue of £160,000, has been unable to pay any dividend for 1902-03, although 5 per cent. was distributed in the previous year, and 10 per cent. in 1900-01. According to the directors' report, orders were received somewhat irregularly, being scarce at the beginning, but numerous in the second half of the year. The situation on the open market for manufactures has so shaped itself that prices no longer allow of a profit being realised. Among the losses incurred during the year, were considerable sums due to the supply of steam turbines and Johnston presses, and losses also occurred on the Russian business, which is now being concentrated at Warsaw, and the Moscow department discontinued. The Milan branch is to be transferred to an Italian Oerlikon Co. which has yet to be formed for the purpose. After providing for working expenses and writing off the losses, the latter of which has necessitated appropriations from the reserve fund, the net profits amount to £242, as compared with £16,950 in the preceding financial year. There is therefore no distribution for the year, while the drawing upon the reserve fund has reduced it to £16,000. A number of orders remained on hand at the opening of the current year and an increased turnover is expected.

The Bank for Electrical Enterprises, of Zurich, which has hitherto acted as a financial trust for the undertakings which have been promoted or established by the Allgemeine Electricity Co., of Berlin, has now decided to extend its sphere of activity by becoming, as is provided by its statutes, a general financial institute for the electro-technical industry, and a branch will be founded at Berlin for the furtherance of this object. An explanation of the reversion to the original purpose of the company is to be found in the possession of considerable funds in cash, as a result of the advantageous sale of shares in different concerns and the probability of the funds being increased to a total of £800,000 in the current financial year. The banking company intends to devote attention in the future to the assistance of undertakings which are in a backward condition owing to the lack of financial support.

The Franco-Swiss Electrical Industry Co., of Geneva, which is interested in various lighting, power and industrial enterprises in France, Italy and Switzerland, is unable to make any distribution for 1902-3 as in the two preceding years. As compared with 1901-1902, the net profits show a shrinkage of over £40,000, owing to the necessity for making provision for the depreciation of securities, the actual profits being £19,111, which has been carried forward to the next account. The company has a share capital of £1,000,000, and several months ago issued bonds to the extent of £200,000, while an attempt to place a further emission of bonds to the extent of £200,000 has recently been made.

Austrian Works.

The Siemens & Halske Co., of Vienna, as is indicated by its title, is a branch of the Berlin company of the same name, and has a share capital of 20,000,000 kronen. During 1902-3 the course of business was not so unfavourable as in the preceding year, although the financial results are by no means satisfactory. In the year of the completion of the conversion of the Vienna tramways to electric traction, the net profits amounted to over 1,196,000 kronen, but a year later they declined to 118,153 kronen, although a recovery to 784,025 kronen has taken place in the past year. The general complaints made respecting the delay in the payment of accounts are illustrated by the large increase in the debts owing. The prices prevailing during the year were low and continue in this condition at the present time, although the works seem to be more actively employed. Since the termination of the financial year the company's heavy electrical engineering departments have been transferred to the Austrian Siemens-Schuckert Works Co. It is considered that a satisfactory sphere of employment lies before the Vienna branches, which still remain independent—namely, the cable factory, the light electrical departments, and the manufacture of railway safety appliances.

The Austrian Schuckert Works Co., of Vienna, reports that notwithstanding the prevalence of low prices and a diminution in the demand, it was possible to keep the works fully employed and actually increase the output during 1902-3. Among the numerous contracts booked or carried out in the year, it is noteworthy that the greater portion had reference to installations for the electrical transmission of power. The net profits amounted to 789,949 kronen, as compared with 729,155 kronen in the previous year, and a dividend at the rate of 7 per cent. has been declared on a share capital of 9,000,000 kronen, as compared with 7 per cent. on 8,000,000 kronen in 1901-2. The termination of the financial year has been followed by the amalgamation of the company with the heavy electrical engineering departments of the Vienna Siemens and Halske Co.

The report of the United Electricity Co., of Vienna, attributes the lack of successful results during 1902-3 to the unfavourable situation of trade in general and the depression in prices due to the severity of competition. Even the many orders obtained were only procured by an expensive extension of the commercial organisation, and the endeavours made to reduce the cost of production proved to be futile. In the previous year the company, which has a share capital of £200,000, only earned net profits amounting to £3,220, but the past year's trading, after absorbing the balance brought forward, has resulted in a deficit of £18,754, which has been carried forward, although the deficiency could nearly have been extinguished by appropriating for this purpose the entire sum standing in the reserve fund. The company controls the majority of the share capital of the Buda-Pesth United Electricity Co., which is mainly engaged in the manufacture of glow lamps, but which has so far not yielded any return to the parent concern.

Among the Russian manufacturing works may be mentioned the St. Petersburg Lahmeyer Co., which has closed the year 1902-3 with a loss of £17,279 as compared with a loss of £11,847 in the previous year; while the Russian Schuckert Co. has incurred a loss of £357 as against a deficit of £4,890 in the preceding 12 months. In this connection it is reported that negotiations are proceeding with a view to the amalgamation of the Russian branches of the Schuckert and Siemens & Halske companies, or the negotiation of a working agreement between them.

THROUGH BOOKING AND CONVEYANCE OF PASSENGERS, PARCELS AND MERCHANDISE ON TRAMWAYS AND LIGHT RAILWAYS.

By T. UPTON,
Goods Traffic Manager to the South Lancashire Tramways Co., &c.

(*Concluded from page* 442.)

In any such arrangements made for through booking, it would, of course, be understood that each company or authority, party to the through booking had the power, if they considered it necessary at any time, to check the statements rendered with the ticket issue books of the other partner or partners to the arrangement, although the power to do so would, in all probability, be very rarely, if ever, exercised.

It would not be a difficult matter to draw out a set of tickets to meet the requirements of the various through routes, and sections requisite thereto, or to easily distinguish between "single" and "return" tickets, the question of overlapping stages beinge liminated in connection with through-booked passengers.

Parcels and heavy merchandise traffic.—In dealing with these traffics the matter of terminal charges must be taken into account, independently of the question of ordinary mileage and divisions of receipts incidental thereto.

In the case of small parcels conveyed by passenger train, the terminal charges allowed to the forwarding and receiving companies, where such are concerned, are definite and fixed, no variation being necessary on account of differences in classification, as in the case of merchandise conveyed by goods trains at tonnage rates, according to the Railway and Canal Traffic Act and schedules included in the Confirmation Orders Acts subsequent thereto.

It is easy, therefore, to see that provided terminal charges be agreed upon there should be no difficulty in arranging through workings and bookings of small parcels, say, up to 100 lbs. weight each, on mileage basis.

The terminal charges should be based on the supposition of an amount sufficient to meet the working expenses of a depôt, including collecting or delivery services, clerical and other labour charges, management, &c., calculated on the volume of traffic that may reasonably be expected from the development of a parcels service, as a whole. It may be said that terminal charges are not allowed to tramways and light railways, according to their schedules of rates; this is quite agreed, but the charges for carriage allowed by the schedules are sufficient to allow of a reduction therefrom for terminal purposes, although not actually mentioned, and would not be quoted to the public any more than in the case of railway parcels rates, terminal charges being a matter of arrangement between the carriers for services performed

beyond that of actual conveyance, and a payment over and above the mileage proportion for such work.

It would, of course, be necessary in many instances to tranship parcels *en route*, possibly more than once; but again falling back on the railway system, no extra allowance would be made over the mileage proportion due to any particular section being a separate undertaking for the services rendered, unless by special arrangement with all concerned, as in the case of parcels possibly having to be conveyed across a town, or some distance from one system to another not forming a through route, thereby entailing extra labour and expense over and above that necessary for handling traffic on a continuous through route.

The question of through working of heavy merchandise is one of much importance, as, quite independent of traffic passing by railway, there exists in all districts a considerable and ever-increasing road traffic; provided a cheaper and more expeditious service by tramway was introduced, traders in general would not, I think, be slow to take advantage of it, and thus the necessary facilities for through working could not for long be withheld by any authority or undertaking, for without doubt, such traffic, properly controlled, would prove of no inconvenience in town or country, but would be a source of profit to the tramways, be they owned by corporations, local authorities, or companies, as well as a convenience to the ordinary traffic during the daytime, to the extent to which it removed other traffic off the streets.

The terminal charges in respect to heavy merchandise at depôts, sidings, &c., are not so easily disposed of as in the case of small parcels, owing to the various classes and descriptions of goods, the accommodation and facilities for handling necessary to the proper working of the same; however, with these settled satisfactorily, there would be no difficulty in arranging through workings on mileage divisions of net receipts after deducting the terminal charges and special allowances that might be agreed upon in certain circumstances similar to those obtaining on railways.

EARTH CONNECTIONS.

By W. MOON.

It is very generally supposed that a damp situation and a porous soil are the only necessary conditions required for a good earth connection. This, however, is not the case; much depends upon the nature of the soil in which the earth plate is sunk.

While sands and gravels seem to conduct principally by the moisture or damp clay in the interstices, clays would appear to have a true conductivity, as some of them give a lower resistance than that of the water with which they are moistened. The conductivity of certain rocks would also seem to depend not only upon the water they contain, but also upon the nature of the rocks themselves.

The resistance of fresh waters obtained from various sources does not vary as much as might be expected. Some freshly collected rain water measured 12,000$^{\omega}$ per cb. centim., but a number of samples of water from streams, rivers, and wells did not depart much from a mean resistance of 2,400$^{\omega}$ per cb. centimetre. The Thames water at London Bridge gave 2,130$^{\omega}$, and sea water 330$^{\omega}$ per cb. centimetre.

The presence of lime in water reduces its resistance. A saturated solution of lime water measured 750$^{\omega}$ per cb. centimetre.

The boiling of water does not appreciably affect its resistance. The resistance of water, however, varies with the temperature. Thus water at 60° F. having a resistance of 2,400$^{\omega}$, fell to 1,400$^{\omega}$ at 150° F.

Pure clay has the lowest resistance of any natural soil. A sample of London blue clay gave 870$^{\omega}$ per cc., and a sample of London red clay 950$^{\omega}$ per cc. Other clays containing sand gave twice, or more than twice, this resistance.

The amount of moisture in clays does not much affect their resistance. Thus a sample of clay and sand when in a plastic condition measured 1,900$^{\omega}$ per cc., and when dried quite hard it measured 1,850$^{\omega}$ per cc.

The high conductivity of clays seems to be due to the smallness of the particles of which they are composed. A similar effect is noticed with sands. Thus silver sand measured 6,400$^{\omega}$ per cc., but ordinary river sand 19,000$^{\omega}$ per cc. Ordinary whiting gave 1,900$^{\omega}$ per cc.

The long-continued action of the current lowers the resistance of soils, and rest raises it.

Thus, with a current of $\frac{1}{1000}$ ma. per cm^2, the following results were obtained :—

	Resistance per c.c. when current first put on. Ohms.	Resistance per c.c. after current on a week. Ohms.
Yellow clay	2,600	2,100
Soft blue clay	2,500	2,350
Clay and gravel	4,500	4,050
Clay, sand and gravel	23,500	19,500
Sand and gravel	10,800	8,400
Sand and gravel from near the sea ...	6,800	5,000
White clay	3,600	1,900
Blue clay and gravel	7,500	—
Peat	4,500	—

In their natural state in the earth all rocks are probably saturated with water except at their surfaces, and the most satisfactory manner to measure their resistances is after they have been soaked in water for some time. While a short soaking of a day is sufficient for some of the softer sandstones, some of the more closely-grained limestones only become saturated throughout their mass of several centimetres after being soaked in water for several weeks.

Before measuring the resistance of rocks it is necessary to wipe their surfaces dry. Connection can then be made by spreading a thin layer of clay on two opposite surfaces, and pressing sheets of tinfoil firmly on the clay.

	Resistance per cubic centimetre. Ohms.
Green sandstone	8,000
White „	8,750
Grey „	10,000
„ „	28,600
Red „	16,000
Blue „	29,000
Yellow „	16,000
York stone	58,000
Aberdeen granite	45,000
Guernsey granite	850,000
Slate	132,000
Asphalte rock	170,000
Limestone	690,000
Phosphate of lime, black	47,000
„ „ white	1,000,000
Portland cement	6,000 to 2,400 average 1,500
Concrete	38,000
Artificial paving	42,000
Hard brick	2,340

The resistance of some of the more porous of rocks is not much greater than that of the mixed gravels and clays, and such rocks must play a considerable part in the conduction of electric currents in the earth.

As there is an increase of temperature with increase of depth, the low lying rocks would conduct better than those of a similar nature near the surface.

The presence of minerals in rocks greatly reduces their resistance. A sample of copper ore measured 260$^{\omega}$ per cc., and it is quite conceivable that an electrical test might be used with advantage to determine the proportion of metal in a sample of ore.

To ensure accuracy of measurement of the resistance of soils and liquids that give an opposing E.M.F., it is necessary that the fall of E.M.F. over the measured resistance should be great compared with the opposing E.M.F., so that while high resistance rocks can be measured in thin slabs, the softer rocks and clays are better measured by taking the resistance between opposite faces of cubes, and good conducting liquids should be measured in long tubes.

The effect of the opposing E.M.F. may be eliminated from the measurements by taking a double balance. If the resistance ω of the soil is measured by the bridge, as in

fig. 1, and the connections are momentarily changed to fig. 2, and r is adjusted until the balance is maintained, then—

$$\frac{E}{2\,\dfrac{R\,R_1}{R+R_1}+r_1}=C\,R \qquad (1)$$

$$\frac{E}{2\,\dfrac{R\,R_1}{R+R_1}+r_1}-e=C\,\omega \qquad (2)$$

$$e=\frac{E\,r}{R_1+r+r_1} \qquad (3)$$

filling the value of e in (3) in equation (2), then from (1) and (2),

$$\omega=R\left(\frac{R_1-r+r_1-r\,r_1\dfrac{R+R_1}{R\,R_1}}{R_1+r+r_1}\right) \qquad (4)$$

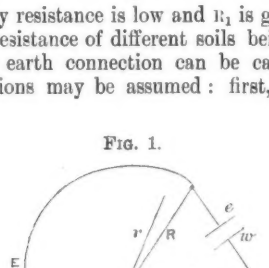
which becomes approximately

$$\omega=R\,\frac{R_1-r}{R_1+r}$$

when the battery resistance is low and R_1 is great.

The specific resistance of different soils being known, the resistance of an earth connection can be calculated. Two different conditions may be assumed: first, the resistance

Fig. 1.



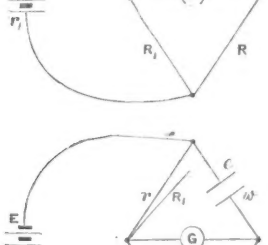


Fig. 2.

with a plate sunk in an infinite bed of uniform conductivity; and secondly, the resistance with the plate sunk in a shallow bed underlaid by a non-conducting stratum of rock.

If the earth plate were a hemisphere sunk with its flat end flush with the surface of an infinite conducting bed of specific resistance S, the resistance of the earth connection would be

$$\frac{S}{2\,\pi}\int_x^\infty\frac{d\,x}{x^2}=\frac{S}{2\,\pi}\,\frac{1}{x}. \qquad (5)$$

where x is the radius of the sphere.

And, if the earth plate were a cylinder of length l and radius x, sunk perpendicularly in a shallow bed of depth l, underlaid by a non-conducting stratum of rock, the resistance would be—

$$\frac{S}{l\,2\,\pi}\int_x^{x_1}\frac{dx}{x}=\frac{S}{l\,2\,\pi}\log_\epsilon\frac{x_1}{x}. \qquad (6)$$

But as no rocks are absolute non-conductors, the resistance with a rectangular plate sunk in the earth would be between (5) and (6), say—

$$\frac{S}{2\,\pi}\,\frac{1}{x^{n-}}, \qquad (7)$$

where n is something between 2 and 1, and would be the nearer to 2, as the conducting layer of soil was deeper, and to 1 as it was more shallow.

From (5) and (7) it will be seen that the resistance under the most favourable conditions of an earth plate 2½ ft. square would be about ¾ of an ohm for a plate sunk in the sea, 3 ohms for pure clays, 10 to 15 ohms for mixtures of gravels and clays, and as high as 40 ohms for some mixtures of sands and gravels or of porous rocks.

The least resistance of an earth connection that I have yet measured, is 7 ohms, and the mean resistance of a large number of measurements was between 15 and 20 ohms.

In sinking an earth plate, it is necessary to put it sufficiently deep to ensure its being surrounded the whole year with soil saturated with moisture. It should be sunk in a hollow, and, if possible, beside a constantly running stream, with the top of the plate below the level of the bed of the stream. If sunk near drains, the plate should be placed beneath the level of the drain.

It should be sunk near gas and water pipes, and, where possible, be connected to them. Of course, a connection to a gas or water pipe is sufficient where such pipe is not likely to be cut for repairs. The resistance of an earth connection made to a water pipe may be but a fraction of an ohm.

Formulas (5) and (7) show that even under the most favourable conditions the resistance of an earth connection is inversely proportional to the dimensions of the plate, and that in many cases it would be but little decreased by using a larger plate. A number of small plates, sunk some distance apart, is in any case a more efficient earth connection than one large one; and this is the more so, if the conducting layer of soil is shallow.

In filling in the hole in which an earth plate is sunk, the earth should be well rammed, for it is found that the resistance decreases for some time after the plate is sunk, owing to the sinking down of the soil.

Whenever the resistance of a telegraphic line terminated by two earth connections is measured, it is always found that the apparent resistance of the circuit varies with the application of the testing current, and generally the measurements with the positive and negative currents are different. These results are due to the E.M.F. that is always present at the earth connections.

This E.M.F. is the resultant of several forces, each of which is greater or less according to various circumstances. The testing current itself generates an opposing E.M.F., which is greater in proportion to the density of the current at the surface of the plate, and is affected by the dampness and nature of the surrounding soil. There is also present a steady E.M.F. due to the chemical action of the soil upon the plate, to the effects of the currents from other circuits flowing to earth by the same or by neighbouring earth connections, and to the terrestial E.M.F. which results in the so-called earth currents.

The resultant E.M.F. from all these sources has the effect of making the apparent resistance as usually measured of greater value than it really is.

The effect of a steady E.M.F. at the earth connection can best be studied upon a telegraph circuit, and the value of such E.M.F. can be measured with fair accuracy. The effect of the opposing E.M.F. due to the action of the testing current can, however, be best studied in the laboratory.

The steady E.M.F. is recognised by the apparent different resistances of the circuit with the positive and negative testing currents to line, while the opposing E.M.F. due to the action of the testing current itself is recognised by the increase of the resistance with the continued application of the current.

The presence of the steady E.M.F. at the earth connections introduces an error into the measurement of the resistance of the circuit, when the measurement is made in the usual way with the Wheatstone bridge. I shall proceed to show the value of this error, and under what arrangement of the bridge the error may be made as small as possible.

(To be concluded.)

Ashton-under-Lyne Lighting.—The T.C. has fixed the price of energy for street lighting at 2d. per unit, and for theatres at 3d. per unit.

TRANS-ATLANTIC ENGINEERING SCHOOLS AND ENGINEERING.

The discussion on Dr. Walmsley's paper on the above subject was a somewhat lengthy one, but it can hardly be said to have carried us much "forrader." For one thing, the professorial element had it practically all their own way, the practical element—or, at any rate, the manufacturers—not deigning to comment on the paper, which obviously aims at a solution of the vexed question of the best method of obtaining that high standard in the matter of works staff which is indispensable under modern commercial competitive conditions.

Whether we are to attribute this seeming apathy to their being satisfied with the product "born and bred" in their own works, as suggested by Dr. R. T. Glazebrook, or to a preference for a "human machine" easily controllable from one master mind, is not quite clear. It is evident, however, that the absence of the commercial engineer prevents any definite conclusion being arrived at.

The professors as a body did not agree with the impression conveyed by the paper—viz., that we were behind our American *confrères* in the matter of "finished product" turned out from the colleges. For instance, Prof. Armstrong had returned from his American tour with the Mosley Commission well satisfied with English work, and did not think we had so much leeway to make up; Prof. Unwin, commenting on this general bearing of the paper, thought it was perhaps somewhat exaggerated; Prof. Cormack considered that we were ahead of the Americans in the use we made of our laboratories; Mr. H. Erat Harrison thought Dr. Walmsley had represented us as badly as possible; Dr. Fleming considered that the provinces, with their colleges and universities, would be able to more than hold their own.

In contrast to this array of satisfied ones must be mentioned Dr. Glazebrook and Prof. R. H. Smith, who both expressed a general agreement with the opinions of the author, and Mr. Lineham, who thought that England was being out-distanced by America in educational matters.

On the question of the lavish expenditure on American colleges and apparatus, there appeared to be a general opinion that this was not necessary in Britain, Prof. Armstrong even insinuating that there was something to be made out of fine college buildings in America. That it is desirable to expend at a greater rate than at present, was not denied; but a very elaborate laboratory, on the scale of the American laboratories, was not considered an unqualified blessing, it might, in fact, according to Dr. Glazebrook, become a "museum."

Dr. Walmsley appeared to agree with this view of the necessary expenditure, but reminded his hearers that in comparing American and British requirements, the British Empire and not the British Isles would have to be considered—from which one might infer that our self-governing colonies and Indian Empire had neglected educational work, an inference which we believe to be erroneous.

On the question of the relative merits of English and American students, as turned out by their respective colleges, Prof. Armstrong, distinguishing between the education of the world and of the school, was of opinion that, judged from the former standpoint, Americans were superior; they were, however, overtutored, so much so that he didn't know how they escaped with any individuality. He further added that he thought there was some dissatisfaction with the turned-out product among American employers.

Prof. W. C. Unwin doubted the possibility of judging the quality of an (American) examination from the syllabus, and thought we wanted a more critical examination of the whole course of the American student. He suggested the advisability of adding a fourth year's specialised course on to our three years' courses.

Mr. A. P. Trotter considered that a thorough training in physical principles should be given, then the application of those principles to practice would come naturally in due course. He did not consider that the technical details of a man's trade could come under college education.

The very close connection which should exist between the teaching staff and the employer, was emphasised by many speakers, and it was suggested that it only needed more active interest on the part of the employer to overcome much of the present difficulty. If our memory does not deceive us, it is rather more than 20 years since, under the lead of certain prominent textile employers, one of the first English technical colleges was opened in a northern manufacturing town. Since its inception these employers have always assisted with money and plant, in providing for the proper equipment of the college, and, what is far more to the point, have sought after those students who were properly qualified in their respective industries. This may appear to be an exception to the rule, but judging from the numerous technical colleges and schools spread broadcast over Great Britain, nearly all of which (whether municipal or otherwise) originated in and are actively supervised by those interested in local industry, we should hardly like to suggest that it was.

It does not appear to be sufficiently recognised that the scientific aspect of engineering is entirely subordinated to commercial requirements, the satisfactory blending of the two being only acquired after a certain period in the employer's works, and obviously until that time has elapsed he can hardly be expected to assess the true value of his assistants.

We were glad to see that the college workshop was rightly summed up as a means of enabling the student to enter the works not quite a novice.

Dr. Fleming and other speakers criticised the accuracy of the figures given for English engineering students; the latter pointing out that London possessed 12 Institutions equipped with engineering laboratories and attended by 12 to 13 hundred mechanical and electrical students, or including evening students, the number is over 6,000. Dr. Fleming also considered that there was a lack of organisation in the teaching staff as a whole, and pointed out that any scheme which took the engineering departments away from existing Institutions would be likely to involve them in financial difficulties.

It was only natural with such a subject under discussion that extremes should meet, and this was well illustrated by two speakers who suggested, the one that rather than wring our hands for millions of money we should found self-supporting institutions and replace indiscriminate endowments by scholarships to capable students; and the other that there should be expenditure without stint, and that scholarships were not really a gain, as scholarship students were apt to think that they had already achieved success.

THE INTRODUCTION OF THE PREMIUM SYSTEM INTO ADMIRALTY WORKSHOPS.

The Admiralty Authorities, who were among the first to introduce the eight-hours' day, have now gone a step further in introducing the premium system of payment. As has been already pointed out, whilst the premium system is a modified form of piece-work, it does not seem to be so objectionable from the workman's point of view as the plain piece-work system. Some American manufacturers consider that it is not such a good system as the ordinary piece-rate system, in that the inducement to work faster is least when such inducement is most required. It has, however, the advantage that the inducements are not sufficient to encourage scamping, as by no possibility can a man on the system proposed earn double his ordinary rate, whereas on piece-work this can be done, sometimes at the expense of good work. The system to be introduced by the Admiralty on March 14th is, briefly, as follows:—

A certain time is allowed for a piece of work. If the workman satisfactorily completes the work in less than the stipulated time he becomes entitled to a premium varying in amount with the time saved. If, however, he does not finish in the time stipulated he still earns his full day money. There are, no doubt, some of the old-fashioned type of workmen who will purposely not finish the work in less than the stipulated time, but this feeling will soon wear down owing to the natural covetousness of human nature. A man will not stand by seeing another earn over £2 a week, without over exerting himself, whilst he himself is drawing his regular 36s. The premium will be calculated as follows:—

The value of a "premium hour" will be considered to be one-forty-eigthth of the workman's weekly wages, and the amount of premium earned on a job will bear approximately the same relation to the ordinary wages due for the time taken to complete it, as the time saved bears to the time allowed.

To give an example:—Suppose a man is given 48 hours to do a job and does it in 36 hours, he saves one-fourth or 25 per cent. of the time allowed, and accordingly he will be credited with 25 per cent. of the time taken to do the job, which is nine premium hours;

so that a mechanic in receipt of 36s. per week, and whose "premium hour rate" would therefore be 9d., would receive 9 × 9d. = 6s. 9d. premium for this job in addition to his ordinary wages for the period worked.

Similarly, a skilled labourer in receipt of 24s. per week, and whose "premium hour rate" would therefore be 6d., would in the example quoted above receive 9d. × 6d. = 4s. 6d. premium. The time taken will be recorded to the nearest quarter of an hour.

In calculating the premium, the time taken will include all the working hours from the time of commencement of the job up to the time of commencing the next job. Overtime, and night and day shifts will be paid for at overtime rates as at present, but will only count as ordinary hours in the calulation of the "premium."

Lost time, or absence without leave, will count in the time taken. Absence with leave will not be included in the time taken.

If a man's work when finished does not pass inspection, he will receive no premium for that job, unless he can make good the work in the time allowed, in which case he will receive the premium on any saving of time still remaining. There are, of course, other restrictions as to the non-payment of premium on articles that turn out to be defective, and no allowance will be made in the time taken for stoppages occasioned by breaking of straps, stopping of driving machinery, or any other cause, nor will apprentices be at present employed on premium work.

It is to be hoped that the introduction of the premium system will lead to workmen taking an increased interest in their work, and we shall look forward to an account of the working of the system with interest.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Electrician" writes:—"What is the position and risk to a person in having a private telephone overhead wire in the Borough of —— Corporation? We are at present having the electric trams installed in this borough, and I have some 20 to 30 private telephone wires crossing overhead in various districts where the electric cars are worked on the overhead system. One of my customers has been informed that, should a telephone wire break, he would be held responsible for any damage.

"I should like to know whether there is any risk to run in the wires being left intact; or if the wires were taken down and reconstructed with special wire, or removed altogether, is there not compensation due from the said Corporation? I have also several telephone wires to carry out, but am at present prevented from executing this work owing to the unsatisfactory results of the above information."

*** "Electrician's" customer appears to have made an accurate statement when he said that the owner of a telephone wire may be held responsible for the damage caused if the wire should break. In a case which was decided some years ago by a County Court Judge, a telephone wire which was broken owing to the weight of the snow which had fallen upon it, caused a short circuit from the trolley wire of the tramway system, with the result that a horse was killed by electric shock. An action being brought against the tramway company, the County Court Judge held that inasmuch as the telephone company had committed a trespass by allowing their wire to fall on the tramway wire, the tram company could not be held liable, and he consequently gave judgment for the defendants. This would seem to be sound law, and the principle would doubtless be acted upon at the present day.

It is important to observe, however, that under the Board of Trade regulations which are now in force, a tramway company is bound to place guard wires over all naked conductors which are transmitting current at high pressure. These regulations are stringently enforced, and there does not appear to be any reported instance of an accident happening where such guards have been placed in position and properly maintained. In these circumstances, it is conceived that it would be quite safe for "Electrician" to erect the wires in question. He is recommended, however, to obtain a copy of the Board of Trade regulations with regard to overhead wires, and also to ascertain whether the local authority in his district is likely to raise any objection to his wires crossing the streets.

NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

4,918. "Improvements in automatic circuit-breaking safety appliances for use in trolley-wire systems for electric traction." J. Carter, G. Hall and A. Parsons. February 29th.

4,925. "Improvements in electric bell pushes." J. S. Ross. February 29th.

4,927. "Life saving appliance or lifeguard for electric tramcars and railway cars." R. Greenhalgh and W. A. Barnes. February 29th.

4,937. "Improvements in arc lamps." J. D. F. Andrews and The Manufacturing Electric Co., Ltd. February 29th.

4,943. "Improvements in and relating to electric controllers for use with cranes, winches, transporters and similar or other machinery." The Cleveland Bridge and Engineering Co., Ltd., and C. W. Hill. February 29th.

4,953. "Improvements relating to apparatus for automatically interrupting electric current." Aktiebolaget Svenska Elektriska Urbfabriken. (Date applied for under Patents Act, 1901, March 3rd, 1903, being date of application in Sweden.) February 29th. (Complete.)

5,027. "Improvements in the synchronisation of clocks by means of etheric electro-magnetic or electric waves." T. H. Williams. March 1st.

5,054. "Improvements in electrical switches known as tumbler switches." G. Sperryn and W. Cassell. March 1st.

5,064. "Improvements relating to the electrical and automatic working of signals, points and crossing-gates on railways." D. M. Daboo. March 1st.

5,084. "Improvements relating to electrically-propelled vehicles working on the overhead trolley system." E. C. McCracken. March 1st.

5,097. "Improvements in electric meters." F. P. Cox. (Date applied for under Patents Act, 1901, March 2nd, 1903, being date of application in United States.) March 1st. (Complete.)

5,098. "Improvements in electric lamps." C. P. Steinmetz. Date applied for under Patents Act, 1901, March 6th, 1903, being date of application in United States.) March 1st. (Complete.)

5,101. "An improved method of increasing the discharge energy of electrical vibration systems." W. P. Thompson. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany.) March 1st. (Complete.)

5,105. "An improved method of receiving electrical vibrations utilising electrolytic cells." W. P. Thompson. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany.) March 1st. (Complete.)

5,118. "Improvements in or relating to electrical radiators. H. J. Dowsing. March 1st.

5,146. "Improvements in dynamos and electric motors with a view to preventing or lessening sparking at the brushes." W. Armistead. March 2nd.

5,164. "Improvements in electric arc lamps." Crompton & Co., Ltd., and A. J. Hodgson. March 2nd.

5,173. "Improved process and apparatus for the production of metals of the alkali group by electrolysis." E. A. Ashcroft. March 2nd.

5,191. "Improvements in electric and other lamps. J. A. Stevens. March 2nd.

5,193. "A device for collecting gases which are driven or given off electrical furnaces." W. McCaulay. March 2nd.

5,213. "Improvements in and relating to apparatus for conversion of electrical into mechanical energy." W. Giepel, F. M. T. Lange and G. W. Mascord. March 2nd.

5,214. "Improvements in and relating to apparatus for the conversion of electrical into mechanical energy." W. Geipel and F. M. T. Lange. March 2nd.

5,227. "Improvements in supports and guards for conductor rails of electric railways." H. L. Doulton and C. E. Morris. March 3rd. (Complete.)

5,251. "Improvements in electric plug connectors." J. H. Tucker. March 3rd.

5,269. "Improvements in and relating to electric traction systems." H. F. Parshall. March 3rd.

5,289. "Apparatus for disinfecting telephone instruments." R. Redpath and J. Good. March 3rd.

5,294. "Improvements in or relating to electric alarms." J. Kiewert. March 3rd. (Complete.)

5,297. "Improvements relating to electric accumulators or secondary batteries." M.I.P. Electrical Syndicate, Ltd., and A. Blackman. March 3rd.

5,298. "Improvements in fuse boxes for electricity supply mains." J. L. Davis. March 3rd.

5,307. "Improvements in or relating to fuse boxes." E. Roberts and P. Good. March 3rd. (Complete.)

5,463. "A clip with clamps and a combined book of reference and writing slate for general office use, but more particularly for use on telephones and the like instruments. Mrs. C. Plowman. March 5th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

Arc Lamps. J. Brockie. 20,199. September 16th.

Electric Railway Signals. C. P. Bass, T. B. West. 20,230. September 16th.

Electric Switches. L. Burbank. 20,323. September 17th.

Construction of Wire used for the Transmission of Electrical Energy. T. Hopkinson. 20,340. September 18th.

Testing Instrument for Electrical Incandescent Lamps. A. McCaudlish. 20,426. September 19th.

Electric Car Trolleys. J. W. Knowles. 20,438. September 19th.

Means for Operating Rail and Conductor Points from the Vehicle on Electric and other Tramways. C. G. Goord. 20,502. September 19th.

Electro-magnets. T. G. Waterman. 20,555. September 20th.

Signalling Apparatus for Electric Railways. R. J. Sheehy. 20,887. September 25th.

Poles or Electrodes of Electrolytic Apparatus and the like. G. J. Atkins. 21,021. September 26th.

Electric Accumulator Plates. M. A. Adam. (Communicated.) 21,201.

Lighting Miners' and other Lamps by Electricity. W. Patterson and C. Darrah, jun. 21,213. September 30th.

Electrical Switches. C. H. Offord and T. H. Marsh. 21,229. September 30th.

Telegraphic Apparatus for Engines on Shipboard. J. C. Kay and J. G. Kay. 21,301. September 30th.

Secret Electrical Interrupter. E. Zay. 21,267. September 30th.

Electrically Actuated and Controlled Clock. J. A. Carruthers. 21,471. October 2nd.

Trolley Heads for Electric Tramcars. W. H. Cook, T. Cook and W. E. Partington. 21,488. October 3rd.

Electric Cord Grip Lampholder and Shade Carrier. A. M. C. Ioannide and C. Hesford. 21,604. October 4th.

Telephone Apparatus. G. Houbigant. 21,734. October 6th.

Alternating Current Motors. L. Schuler and Ferranti, Ltd. 21,913. October 8th.

Insulators used for Electrically Dividing into Sections Trolley Wires as used on Electric Railways. H. Brecknell, E. M. Munro and H. I. Rogers. 22,023. October 10th.

Overhead Trolley Tracks. W. J. Sumner. 22,188. October 11th.